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A PRELIMINARY REPORT

ON THE

FISHES OF MINNESOTA

ZOOLOGICAL SERIES III

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GEOLOGICAL AND NATURAL HISTORY SURVEY OF MINNESOTA  
HENRY F. NACHTRIEB STATE ZOOLOGIST

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# A PRELIMINARY REPORT

ON THE

# FISHES OF MINNESOTA

119

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ZOOLOGICAL SERIES III

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MARCH 1897  
SAINT PAUL MINNESOTA

# BOARD OF REGENTS

## OF THE

# UNIVERSITY OF MINNESOTA.

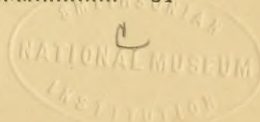
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## LETTER OF TRANSMITTAL.

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THE UNIVERSITY OF MINNESOTA,  
MINNEAPOLIS, MINN., Dec. 10, 1896.

*To the President of the Board of Regents of The University of Minnesota.*

Sir: I have the honor herewith to submit a preliminary report on the fishes of Minnesota.

This report, which should be considered simply as an aid toward a final comprehensive report, has been prepared by Mr. Ulysses O. Cox, Head Professor of the Department of Biology and Geology of the State Normal School at Mankato, who has been assisting in the field work of the survey and has gratuitously prepared this brief statement.

Very respectfully, your obedient servant,  
HENRY F. NACHTRIEB,  
*State Zoölogist.*





# PREFACE.

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The object of this bulletin is, 1. To state in a very brief way most of the facts thus far ascertained concerning the fishes of the state; 2. To indicate those inquiries concerning which information is desired; 3. To stimulate those interested in the subject to assist the zoölogist of the survey as far as possible in collecting data and material for a final report.

It is hoped that by paying some attention to the lines of inquiry noted below, correspondents in different parts of the state may furnish the survey with facts and material that otherwise would be lost. Full recognition of assistance will be accorded in the final report. This final report, as planned, will contain as complete an account as possible of the habits, distribution, structure, development, classification, and economical bearings of our fishes.

Specimens can be sent frozen during the cold weather, and during the summer months they can be shipped packed in salt or sawdust and ice. They should be shipped promptly and should be plainly addressed.

Correspondence is solicited in regard to:—

The abundance, distribution and disappearance of any of the common fishes.

The contents of the stomachs of the large fishes.

Careful measurements and descriptions, following the plan of this bulletin, of fishes that are little known.

Carefully tabulated data concerning any of the fishes here described about which there is any question.

The facts concerning the breeding habits, the diseases, parasites and enemies of the fishes.

Observations on other animals that bear a more or less definite relation to the fishes.

Newspaper clippings and photographs concerning any unusual fish.

In order to determine the adaptability of the lakes and streams in the state to the various fishes it is necessary to know,\* among other things:—

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\*Consult a paper on the Investigation of Rivers and Lakes by Dr. B. W. Evermann, Bull. U. S. Fish Com., 1893, p. 69, from which many of the points in regard to observations on lakes have been taken.

The area, depth and temperature of the water at various seasons of the year, especially the highest and the lowest temperatures in summer.

The thickness of the ice in winter and whether or not there are constantly open air holes.

The purity of the water, whether it is free from organic and inorganic impurities.

The nature of the bottom.

The kind of shores.

The source of the water supply.

The nature of the outlet.

Whether dams or other obstructions at the inlet or outlet or at any other point may interfere with the migration of the fishes.

The rainfall of the region and the prevailing winds.

The species and abundance of aquatic plants and the abundance of smaller animals, such as the Entomostraca, for example. Also the species of trees, shrubs and other plants that are found on the shores.

In a stream the velocity of the current and the rise and fall of the stream should also be noted.

Detailed and accurate maps indicating the present or past condition of lakes are very desirable.

This report consists of rather brief descriptions of the fishes known at present to occur in the state, simple keys by which the species may be determined and very brief notes on the distribution of the various species. No attempt is made to give detailed notes on the distribution, except where the species is thought to be rare, and in several cases where the species is known to be very common the distribution is indicated by a general statement. No originality is claimed for the keys and descriptions, except in a few cases, they having been adapted mainly from Jordan and Gilbert's *Synopsis of the Fishes of North America*; Jordan's *Manual of Vertebrates*; Jordan and Evermann's *Fishes of North and Middle America*, of which the first part has just been issued as Bull. 47 of the United States National Museum, many of the proof sheets of which were kindly loaned to me by Dr. Evermann; and from the various Reports and Bulletins of the United States Fish Commission. Statements, sentences and phrases have been used freely from all of the above works without quotation marks. The descriptions, however, have not been merely copied but have been verified in nearly all cases by the examination of a series of specimens. In writing the descriptions the order of the topics has been determined mainly by



the thought of placing first and most conspicuous those points which would first attract the eye of the untrained observer. This method is somewhat unscientific in many cases, yet it is thought to be best for this report, since it is intended for the use of persons who have not had special training in this line. The nomenclature and arrangement of the various classes, orders, families, genera and species is that of the Fishes of North and Middle America referred to above. The classes, orders and genera have not been characterized and the sub-classes have been entirely omitted.

There has been very little matter published concerning the fishes of Minnesota. An occasional note is found in the Proceedings and the Journal of the Academy of Natural Science, Philadelphia; in the Reports and Bulletins of the U. S. Fish Commission; and several references are found in Agassiz's Lake Superior. A paper on Ichthyological Investigations in Western Minnesota and Eastern North Dakota by Prof. A. J. Woolman of Duluth has appeared as a part of Part XIX. of the U. S. Fish Commission, the proof sheets of which were kindly loaned me by the Fish Commission. These are all the sources of any importance from which information can be gained except from the fishes themselves.

In the museum of the University there is a small collection of fish which was made chiefly in the region of Minneapolis, and classified in 1879 by Dr. T. S. Roberts, and a few specimens that were collected by Prof. Hall, C. L. Herrick and others about the same time or before. In 1891 Professors Nachtrieb and Luggen with A. D. Meeds and A. Bothe made collections in the region of Lake Vermillion. In 1892 under the direction of the Natural History Survey a party consisting of A. Schneider, J. A. Crecelius, F. B. Sumner and Clarke Barrows made collections in Ramsey County and in the region of Mille Lacs. In the same year, under the direction of the U. S. Fish Commission, Prof. A. J. Woolman and the writer made collections in Traverse and Big Stone lakes and tributaries at Brown's Valley, Big Stone Lake at Ortonville, and the Minnesota River and tributaries at Appleton and Montevideo. Mr. Woolman continued the investigations along the Red River of the North and its tributaries to the Canadian line. In 1893 under the direction of the Natural History Survey a party consisting of F. B. Sumner, John A. Crecelius, Clarke Barrows and C. H. Topping made extensive collections in the lakes of Hubbard County and the lakes and streams at the headwaters of the Mississippi as far down as Grand Rapids. Another party consisting of August Bothe, Geo. D. Head, Frank Manson, and Clarence Whitman made extensive



collections near Brainerd in Cass and Crow Wing Counties. In 1894, under the direction of the U. S. Fish Commission, the writer made collections in the lakes in the vicinity of Worthington, Heron Lake and some small streams at Heron Lake, Wood Lake and the Des Moines River at Windom and Lake Washington near Mankato. The same season, under the U. S. Fish Commission, Mr. Woolman and I made collections in the Lake of the Woods and took some observations on Lake Superior; also collections on the Upper Mississippi in the region of Deer River and Grand Rapids and on the St. Louis River and tributaries at Floodwood and Stony Brook. In 1895, under the direction of the Natural History Survey, Mr. L. E. Griffin and I made collections on the Western arm of Leech Lake and its tributaries. I have made collections in the Minnesota and Blue Earth Rivers and several lakes in the vicinity of Mankato each season since the fall of 1891; considerable data and many specimens have been collected in the region of Minneapolis at various times; Prof. J. M. Holzinger of Winona has made a small collection at that place and Prof. Woolman has collected at various places in the northern part of the state and at various times but the results of his later collections have not been published, so are not included in the report.

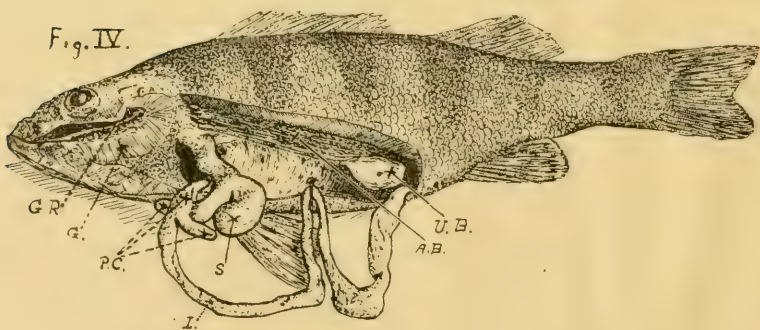
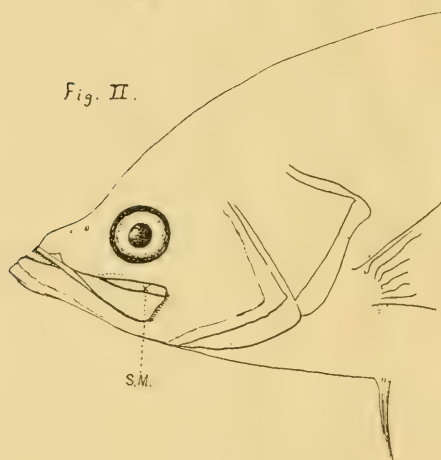
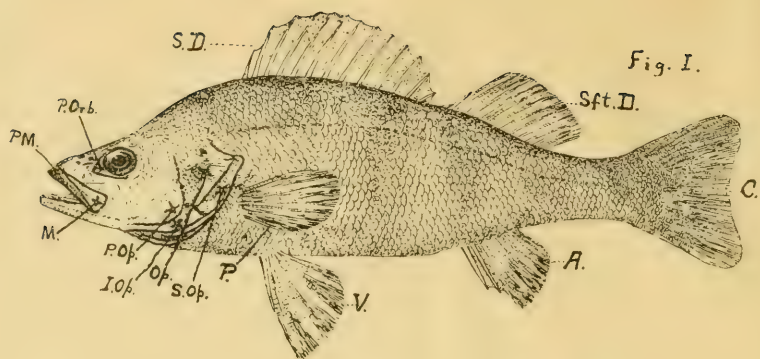
Mr. F. B. Sumner classified and catalogued a large number of the specimens collected by the Natural History Survey but very much of this material had not been opened after being sent in from the field until it was examined for this report. The material and notes of the above collections form the basis of this work.

I here acknowledge my sincere thanks to Dr. B. W. Evermann of the United States Fish Commission who, in addition to the loan of many of the proof sheets of volume I. of the Fishes of North and Middle America, has assisted in the identification of a number of difficult specimens and has offered many valuable suggestions; also to Prof. Henry F. Nachtrieb, State Zoölogist, for many favors and directions in regard to the report.

U. O. C.

MANKATO, MINN., Feb. 18, 1896.







## EXPLANATION OF PLATE.

FIG. I. The Common Perch. (*Perca flavescens*.)

- A. Anal fin.
- C. Caudal fin.
- I. Op. Interopercle.
- M. Maxillary.
- Op. Opercle.
- P. Pectoral fin.
- P. M. Premaxillary.
- P. Op. Preopercle.
- P. Orb. Preorbital.
- S. D. Spinous dorsal fin.
- Sfd. D. Soft dorsal fin.
- S. Op. Subopercle.
- V. Ventral fin.

FIG. II. Head of a Calico Bass. (*Pomoxis sparoides*.)

- S. M. Supplemental maxillary bone.

FIG. III. Common Red Horse Sucker. (*Moxostoma aureolum*.)

- Isth. Isthmus.
- G. U. Gill membranes united to the isthmus.

FIG. IV. The Common Perch dissected so as to show some of the internal organs.

- A. B. Air-bladder.
- G. Gills.
- G. R. Gill-rakers.
- I. Intestine.
- P. C. Three pyloric cæca.
- S. Stomach.
- U. B. Urinary bladder.

# INTRODUCTION.

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## ANATOMY.

Since this report is to be brief and preliminary only those points concerning the anatomy used in determining the systematic position of the different fishes will be considered. To arrive at these points it will be well to study the common perch (*Perca flavescens*), which abounds in all the waters of Minnesota. Besides being a familiar fish, the perch represents a type with which we can compare the anatomy of all our other fishes.

The *fin*s on the back are called the *dorsal*. In the perch there are two, a front or *anterior* one called the *spinous dorsal*, and a back or *posterior* one called the *soft dorsal*. The spinous dorsal possesses stiff, sharp spines called *rays*, while the soft dorsal possesses many-jointed very flexible rays that do not end in hard, sharp points. These fins may be near each other, as is the case with the perch; they may be widely separated, or there may be but one and that a soft dorsal, like the posterior dorsal fin of the perch. In some fishes, cat-fish, white-fish and others, the posterior dorsal is simply a fatty lobe, and it is then called the *adipose fin*. In a few of the cat-fishes this adipose fin is continuous with the tail or *caudal fin*.

The caudal fin may be *entire*, said of it when the posterior edge is about even, or *forked*, when the posterior edge is notched. When the two lobes of the caudal are of about the same size it is said to be *homocercal*, but when the upper lobe is larger and longer than the lower lobe and has in it the continuation of the spinal column, the caudal fin is said to be *heterocercal*, illustrated in the sturgeon.

The fin on the lower or *ventral* side of the body nearest the caudal is the *anal*. It may be made up of soft rays entirely or of both spines and soft rays, as it is in the perch. Its length, kind and number of rays are often essential in identification.

The two fins just in front of the anal are the *ventrals*. These may be placed far forward, as they are in the perch, when they are said to be *thoracic* or *jugular* or they may be near the middle of the belly, as in the suckers, when they are said to be *abdominal*.

The remaining fins are the *pectorals*. These may vary somewhat in size and location, but otherwise are about constant. When

the ventrals are thoracic the pectorals are generally situated on the sides of the body, as is shown in the figure of the perch, but when the ventrals are abdominal the pectorals are more ventral. The dorsal, caudal, and anal are sometimes called the vertical or unpaired and the ventral and pectoral the paired fins.

The *length of a fin* is the distance along its base and the *height* is the length of its longest ray.

The number of rays in any fin is indicated by the arabic numerals alone if soft, but, if it contains spines also, the number is represented by a combination of the Roman and the arabic numerals. The number of rays in the dorsal fin of the perch would be indicated thus: XIII-I, 14, which signifies that there are thirteen rays in the spinous dorsal, one spine and fourteen soft rays in the soft dorsal. The number of rays is important in the dorsal, anal, and sometimes the ventral, but not in the other fins.

The body may be covered with scales, as in the perch, or may be naked, as in the bull-head. When the posterior edge of the scales is smooth they are said to be *cycloid*, when rough or toothed, *ctenoid*. Most fishes have a modified line of scales, the *lateral line*, extending along the sides of the body. Each scale in this line possesses a hole or pore which is related to deeper lying sense organs. The lateral line may be entirely absent or only partially developed, and this is sometimes an essential character in the determination of species. When curved downward it is said to be *decurved*. The number of scales in the lateral line is often very essential. In specific determination it is often essential not only to know this, but to know the number of rows of scales between the front of the dorsal fin and the lateral line, also the number of rows between the lateral line and the vent. A hand lens will be necessary to count the scales in some cases. In the description of the perch the number of scales would be written thus: 5-55-17, which indicates that there are five rows of scales above the lateral line (between the front of the dorsal fin and the lateral line), 55 in it and 17 below (between the lateral line and the vent). These numbers are not absolutely constant and those given in the descriptions are generally averages.

Just in front of the pectoral fins of the perch on each side of the body are the gill openings. The posterior portions of the coverings to these openings are the *opercles*, which name applies strictly to the bones themselves (Fig. I., Op.).

Along the lower side of the opercle is the *subopercle* (Fig. I., S. Op.). In front of the opercle is the *preopercle* (Fig. I., P. Op.), which



borders the *check* on its posterior and ventral edges and which in the perch is toothed or *serrate*. Under the preopercle and in front of the subopercle is the *interopercle* (Fig. I., I. Op.) The bone just in front of the eye is the *preorbital* (Fig. I., P. Orb.); the one just below the eye is the *suborbital*, and this bone sometimes bears a *bony stay* which extends across the cheek towards the preopercle.

The mouth varies greatly in the different species of fish, but that of the perch may be considered typical. Each side of the upper jaw is formed by the *premaxillary* bone which bears teeth. (Fig. I., P. M.). At the middle of the snout there is a backward projection on the premaxillary, and when this and the remainder of the bone is fastened by the skin and muscles alone the premaxillaries can be drawn forward, and are then said to be *protractile*. This character is often essential in identification. Back of the premaxillary, on each side of the head, is the *maxillary* (Fig. I., M.). This bone varies greatly in the different families. Thus in the cat-fish family it is much absorbed and ends in a long fleshy filament called a *barbel*, while in the perch it is well developed. In the bass and sunfish there is an additional supplemental bone on the upper side of the maxillary (Fig. II., S. M.), the presence or absence of which is essential in determining the species of sun-fish. The dentary (tooth bearing) bones form the lower jaw. The mouth is said to be *inferior* when drawn down like that of the sucker, *horizontal* when about on a line with the axis of the body, and *oblique* when opening at an angle like that of the perch and bass.

The thin membrane under the opercle and sub-opercle is the *branchiostegal membrane*, and the curved bones in it are the *branchiostegal rays*, which, in the perch, number seven. The number of these rays is often an essential character. The narrow part of the body near where the branchiostegal membranes of each side join is called the *isthmus* and when the gill membranes are joined to it (Fig. III.) they are said to be *united to the isthmus*, as is the case in the red horse sucker. When joined to each other and not directly to the body, as in the perch, they are said to be *free from the isthmus*.

For the reason that the size of the mature fish is an indefinite thing most of the measurements used are comparative. The length, however, is given and, when so, it is supposed to be the average length of the mature fish. This length is the distance from the tip of the snout to the base of the caudal fin, or end of the spinal column, and not to the tip of the tail. *Head in length* means the number of times the distance from the tip of the snout to the posterior edge

of the opercle is contained in the length of the fish. *Depth in length* means the number of times the greatest distance from the back, or dorsal side, to the belly, or ventral side, is contained in the length of the fish. *Eye in head*, the number of times the width of the entire eye is contained in the head, measuring from the tip of the snout to the posterior edge of the opercle. *Eye in snout*, the number of times the width of the eye is contained in the length of the snout, measuring from the anterior edge of the eye to the tip of the snout. Occasionally the length of spines, length of fins and also other parts are compared with the total length and with other measurements. The above expressions are often abbreviated as "Head 4," which means that the head is contained four times in the length of the fish. A fish is said to be *compressed* when flattened laterally, as is the case with the white-fish and even the perch, and *depressed* when flattened from above, or *dorso-ventrally*. The head of the cat-fish is much depressed.

The heads of the various species vary greatly in other respects than those already considered. There are always four nostrils, the posterior and anterior on each side, being near each other or well separated. In the cat-fishes the posterior nostril is accompanied by a barbel. In addition to the nasal and maxillary barbels there may be barbels on the lower jaw. The snout in some fishes is long and pointed, while in others it is blunt and rounded. It is necessary to study the snouts in identifying minnows.

Besides the teeth in the upper and lower jaws already referred to, some fishes have teeth on the *vomer*, a bone located under the nasal openings in the front of the roof of the mouth, on the *palatine bones*, which are located just back of the vomer, on the *pterygoids*, which are located back of the palatines, and some on the tongue itself. Teeth located in any or all of the above named places are known as the *ordinary teeth*. In some fishes they are present on all these bones, while in others on only a portion of them, and in many there are no ordinary teeth at all, viz., the suckers and minnows. The perch has teeth on the upper and lower jaws and the vomer.

Fishes breathe by means of *gills*, the perch having four pairs borne on the curved bones known as the *gill-arches*. Each gill is composed of numerous fringe-like filaments through which the blood circulates and comes in contact with the oxygen absorbed in the water. The openings between the gills are known as the *gill-slits*. The one found behind the fourth gill in the perch is absent in some fishes. On the front and sides of the gill arches are the

*gill-rakers* which vary greatly, in the different species of fish (Fig. IV., G. R.). Occasionally the nature and the number of the gill-rakers borne on the first gill arch is important in identification. If a description should state that the gill-rakers were 5+15 this would indicate that there were 5 above the posterior angle (Fig. IV., P. A.) of the arch and 15 below it; if X+15 it would indicate that the number above the posterior angle was indefinite and the number below 15. The gill-rakers can be counted in most fishes by lifting the opercular flap.

The bones of the fourth gill arch and those of the fifth arch are modified and bear teeth, the former being known as the *upper pharyngeals* and the latter as the *lower pharyngeals*. In the perch these teeth are very numerous, fine, and set in several masses, usually two masses in the upper and two in the lower. It is often necessary to know the nature of the lower pharyngeal bones and teeth in identification, especially in the suckers, minnows and sunfish. In the suckers these teeth are arranged in a single row on each side, each row containing numerous teeth which are in some species all of about the same size; in others the lower teeth are very large, graduating to smaller ones as they proceed upwards. In the minnows they may be either in one or two rows, but in any case the outer row contains the largest teeth and scarcely ever more than five of them. Teeth in this row may have developed on each a grinding surface and in some species of fish they are hooked.

It will be necessary for those who expect to identify minnows to make themselves acquainted with the different kinds of pharyngeal teeth. These teeth may be removed from a fish without mutilating its general appearance by lifting up the gills and loosening the nearest pharyngeal bone with a strong needle and lifting the bone out. If the teeth are stout they may at once be freed from the adhering flesh with a needle or brush, but if they are weak, as is the case with most minnows, the mass of the flesh had better be removed gently and then the bone be laid aside until the remainder dries; otherwise some of the teeth will be removed in the operation and the conclusion will be incorrect. The teeth in the second row are very liable to be broken in cleaning. In examining a fresh fish some prefer to boil the bones with the flesh before attempting to remove the latter. In describing the various species of fish the pharyngeal teeth are generally indicated by a formula. Thus, 2, 4-5, 2 signifies that there are two teeth in the lesser row on one side, four in the main row on the same side, five in the main row on the other side and two in the lesser; 4-4 signifies that there are two main rows with four teeth in each.



In the sun-fish the pharyngeal bones are similar to those of the perch and in the identification of this group of fishes much depends on the sharpness of the pharyngeal teeth and the manner in which they are massed together.

On the underside of the gill-flap, where the opercle joins the preopercle, there are in some fishes a set of false gills called *pseudodobranchia*. In most of our fishes these are small or even absent, but in a few they are of family importance, viz., the Serranidæ or Sea Bass, represented by our white bass, *Roccus chrysops*.

The alimentary canal in the perch consists of the œsophagus, stomach, small intestine and large intestine. The stomach, and, in fact, the entire alimentary canal varies greatly in the different orders and families of fishes. In the perch the small intestine leaves the stomach toward the latter's anterior end and just at the beginning of the intestine there are three tube-like appendages known as the *Pyloric cæca* (Fig. IV., P. C.). In the white-fish the pyloric cæca are very numerous and in some fishes their number is one of the specific characters, viz., the wall-eyed pikes (*Stizostedion*). It is generally considered that carnivorous fishes possess short intestines and herbivorous ones long intestines. In certain minnows the length of the intestine is an important generic character, hence it is very often necessary to open the abdomen and examine the intestine. In a minnow called the stone lugger (*Campostoma anomalum*) the intestine is very long and coiled many times around the air bladder. In a few fishes there is a spiral arrangement in the intestine known as the *spiral valve*.

The *air-bladder* is a sac, situated in the upper portion of the abdominal cavity of fishes, which contains gases and which can be compressed by the action of the muscles or allowed to expand and thus regulate, in a measure, the specific gravity of the fish. In some of the lower orders this air-bladder is cellular and connected by a tube with the œsophagus and, it is supposed, can be used to some extent as a lung; but in most of our fishes it is not connected with the exterior and is not divided into more than two or three divisions. Occasionally the number of the divisions in the air-bladder is essential in determining the genus, and in this case the abdominal cavity must be opened and the air-bladder examined

# THE FISHES OF MINNESOTA.

---

## KEY TO THE CLASSES.

- A. No paired fins; skeleton not well developed; mouth a sucking disk without jaws. . . . (Lampreys.) **Marsipobranchii**, 8\*  
AA. Paired fins and bony skeleton well developed. (True fishes.) **Pisces**, 10
- 

Class **MARSIPOBRANCHII**. The Lampreys.

Order **HYPEROARTII**.

Family **PETROMYZONIDÆ**. The Lampreys.

According to Theodore Gill the lampreys are not included with the fishes, but are placed in a separate class, differing from the true fishes in having very rudimentary skeletons. The body is long and eel-shaped; mouth somewhat circular and beset with horny teeth which point towards the center. On each side of the body just back of the head are seven small, circular holes, the gill openings. There is but one nostril, and that is located on the top of the head just in front of the eyes; dorsal fin notched; a spiral valve in the intestine. The young of the lamprey undergo a sort of metamorphosis. Being so different from anything else the lamprey is easily recognized. It migrates in the spring with the fishes and is often attached to them. With its sucker-like mouth it can work its way into the body of the fish and may even cause the death of its host. The fish's eye is the part often attacked.

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\*These numbers refer to pages.

Genus **ICHTHYOMYZON** Girard.**KEY TO THE SPECIES OF ICHTHYOMYZON.**

- A. First row of teeth above the mouth (supraoral lamina, or maxillary tooth) two pointed (bicuspid); no bicuspid teeth on the sides of the mouth. . . . . **concolor.**
- AA. First row of teeth above the mouth three pointed (tricuspid), some of the teeth on each side of the mouth bicuspid. . . . . **castaneus.**

***Ichthyomyzon concolor*** (Kirtland).

The row of teeth above the mouth consists of two cusps; row below the mouth with 7 cusps; all the other teeth simple and arranged in about four concentric circles around the mouth. Head contained  $7\frac{1}{2}$  times in the length. Head with gills contained  $4\frac{3}{4}$  times in the length. Fifty-one muscular bands between the last gill opening and the vent. Color bluish, occasionally marked with dark spots; a blue spot above each gill opening. Generally small but individuals may reach a length of 12 inches. Very common in the Lake of the Woods, where it is parasitic on the sturgeon and other large fish. Twenty-eight fine specimens were taken in the above mentioned region in 1894 (Nat. Hist. Surv.).

***Ichthyomyzon castaneus*** Girard.

Three closely set teeth in the first row above the mouth; a row of bicuspid teeth on each side of the mouth; 7 to 12 pointed teeth in the row below the mouth; all other teeth simple and somewhat hooked; teeth of this species a little longer than those of the next. Dorsal fin continuous with the caudal but broadly notched. Color somewhat yellowish, varying to brown. Length 10 inches. A specimen taken in 1853 by Dr. Geo. Suckley is listed from Galena, Minn., in the Rept. Pac. R. R. Surv., Fishes, p. 381, by Charles Girard. The same is referred to in Jordan & Gilbert's Synopsis, p. 16. Three specimens of Lamprey from the Red Lake River are named as *Ammocetes branchialis* by Prof. A. J. Woolman (Report U. S. Fish Comm., 1893, p. 369). I have examined one of the specimens taken by Mr. Woolman, and it is evidently *P. castaneus*. Its supraoral lamina consists of 3 closely set teeth, there is a row of 4 bicuspid teeth on each side of the mouth and the infraoral lamina (the row below the mouth) has 7 cusps. A poorly preserved specimen was taken from the Minnesota River at Mankato in 1892 which seems to be this species.



# Class **PISCES**. The True Fishes.

## KEY TO THE FAMILIES OF PISCES.

- A. Ventral fins present, abdominal.
  - B. Dorsal fins two, the anterior rayed, the posterior adipose.
    - C. Body not covered with scales; head with four to eight barbels; dorsal and pectoral fins with a stout spine.
      - (Cat-fishes) **Siluridæ**, 15
    - CC. Body covered with scales and without barbels or spines.
      - D. Head not covered with scales; maxillary bones distinct.
        - E. Scales ctenoid; margin of the upper jaw formed by the premaxillaries alone.
          - (Trout-perches) **Percopsidæ**, 52
        - EE. Scales cycloid; maxillary bones forming a part of the upper jaw; stomach with many pyloric cæca. (White Fish, Trout) **Salmonidæ**, 43
      - BB. Dorsal fin single, preceded by several unconnected spines; very small fishes. . . . (Sticklebacks) **Gasterosteidæ**, 51
      - BBB. Dorsal fins two, the anterior of three to eight spines; the posterior of soft rays; anal spine one.
        - (Silversides) **Atherinidæ**, 53
      - BBBB. Dorsal fin one, composed of soft rays only.
        - C. Tail with spinal column ending in its upper portion (heterocercal).
          - D. Caudal fin forked.
            - E. Snout long, broad and shovel-like, nearly one-half the length of the body. Body naked. . . . (Paddle Fishes) **Polyodontidæ**, 12
            - EE. Snout shorter; body covered with bony shields. . . . (Sturgeons) **Acipenseridæ**, 12
          - DD. Caudal fin not forked.
            - E. Jaws long, the sharp teeth conspicuous.
              - (Gar-fishes) **Lepisosteidæ**, 14
            - EE. Jaws short, head thick; dorsal fin long.
              - (Dog-fish) **Amiidæ**, 15
          - CC. Tail with the spinal column ending in its center, lobes equal (homocercal).
            - D. Scales cycloid.
              - E. Head scaly.
                - F. Upper Jaw not protractile; its posterior edge formed by the maxillaries.
                  - G. Teeth unequal, coarse and sharp.
                    - (Pikes; called pickerels in Minnesota) **Luciidæ**, 48
                  - GG. Teeth equal, weak and set close to each other. (Mud Minnows) **Umbridæ**, 48

- FF. Upper jaw protractile; formed entirely by the premaxillaries.  
(Killifishes) **Poeciliidae**, 50
- EE. Head without scales.
- F. Gill membranes united with the isthmus; ordinary teeth absent.
- G. Dorsal fin with less than ten rays; pharyngeal teeth in one or more rows, less than eight in the main row.  
(Minnows) **Cyprinidae**, 26
- GG. Dorsal fin with ten or more rays; pharyngeal teeth in one row and numerous.  
(Suckers) **Catostomidae**, 20
- FF. Gill membranes free from isthmus.
- G. Lateral line present; tongue with sharp teeth.  
(Moon-eyes) **Hiodontidae**, 42
- GG. Lateral line absent; mouth small and toothless; stomach gizzard-like.  
(Gizzard Shads) **Dorosomidae**, 42
- AA. Ventral fins present, throacic or jugular.
- B. Body covered with scales or bony plates.
- C. Rays of the ventral fins I, 5.
- D. Vomer with teeth.
- E. Anal spines, one or two.
- F. Anal rays, less than twenty. (Perch) **Percidae**, 62
- EE. Anal spines, three.
- F. False gills (pseudobranchia) on the under side of the opercles small and covered by skin.  
(Sunfishes) **Centrarchidae**, 54
- FF. Pseudobranchia well developed.  
(Sea Bass) **Serranidae**, 72
- EEE. Anal spines 4 to 10. (Sunfishes) **Centrarchidae**, 54
- DD. Vomer without teeth.
- E. Anal spines, one or two; a large slit behind the fourth gill.
- F. Lateral line extending on the caudal fin; snout scaly.  
(Drums) **Sciaenidae**, 73
- FF. Lateral line not extending on the caudal; snout not scaly.  
(Perch) **Percidae**, 62
- CC. Rays in ventral fins not I, 5.
- D. Dorsal fin of spines anteriorly; soft rays posteriorly.
- E. Vent far forward; ventral rays 7; dorsal spines 3 or 4.  
(Pirate Perches.) **Aphredoderidae**, 53
- EE. Vent normal; ventral rays I, 1; dorsal spines unconnected.  
(Sticklebacks) **Gasterosteidae**, 51
- DD. Dorsal fin of soft rays only; dorsal and anal free from the caudal.  
(Cod-fishes.) **Gadidae**, 75

BB. Body scaleless, smooth or more or less prickly or warty.

D. Cheek (suborbital bone) with a bony stay.

(Blobs) **Cottidæ**, 74

DD. Cheek without a bony stay; dorsal spines 4 to 6.

(Sticklebacks) **Gasterosteidæ**, 51

AAA. Ventral fins absent.

B. Body long and snake-like; skin covered with elongate, imbedded scales which are arranged at right angles

with each other. . . . . (Eels.) **Anguillidæ**, 41

## Order **SELACHOSTOMI**.

Family **POLYODONTIDÆ**. The Paddle-fishes.

Body covered with rather smooth skin; snout prolonged into a long, thin, paddle-shaped projection which is somewhat flexible, and whose upper surface is somewhat reticulated. The mouth is large; there is no tongue present and no barbels on the head. Tail heterocercal. But one genus and one species found in North America.

Genus **POLYODON** Lacépède. Paddle-fishes.

**Polyodon spathula** (Walbaum). Paddle-fish. Spoon-bill. Duck-billed Cat.

A peculiar fish which is at once recognized by the long paddle-shaped snout that reaches about one-third the length of the body; skin on the opercle extending in a long narrow flap; gill membranes connected, but free from the isthmus; teeth numerous but small, disappearing with age; tail heterocercal; gill rakers long and in two rows; length six feet; color bluish or greenish; common in the larger streams of the Mississippi valley. Its food is thought to consist of the small life forms which it roots from the mud with its paddle-shaped bill. Specimens have been taken in Minnesota from the Minnesota River at Mankato (Cox, 1894), and from the Mississippi River at Minneapolis (Nat. Hist. Surv.).

## Order **CHONDROSTEL**.

Family **ACIPENSERIDÆ**. The Sturgeons.

Body long, spindle-shaped, covered with bony plates, some of which are small and flat, while others are keeled and arranged in rows. The snout is usually somewhat triangular and projects beyond the mouth. Mouth inferior, toothless, extensible for sucking up food; four barbels in front of the mouth; gills four in number; tail heterocercal. There are no branchiostegal rays; head covered with bony plates; gill membranes joined to the isthmus; dorsal and anal fins inserted far back; air-bladder large. Two genera and two species occur in Minnesota.



## KEY TO THE GENERA OF ACIPENSERIDÆ.

- A. Snout not flat but rather conical; spiracles present; bony plates not coming together on the tail; gill-rakers long and not fan-shaped . . . . . (Common sturgeon) **Acipenser**.
- AA. Snout flat, broad and shovel-shaped; no spiracles present; bony shields coming together and completely covering the tail; gill-rakers fan-shaped. . . . . (Shovel-nosed Sturgeon) **Scaphirhynchus**.

Genus **ACIPENSER** Linnæus.

**Acipenser rubicundus** Le Sueur. Lake Sturgeon. Rock Sturgeon.

Young with snout long, somewhat like *Scaphirhynchus platyrhynchus*; bony shields much keeled with hooked spines; adult snout comparatively much shorter than in the young; shields disappearing with age on the lower parts and becoming smooth on the upper surface; dorsal shields 11 to 16; lateral shields 30 to 39; ventral plates 8 to 11; three shields in a single row between the anal fin and vent. Dorsal with 35 rays and anal 26. A large fish which reaches a length of 6 feet and a weight of one hundred pounds. Two mounted specimens are now in the museum of the University of Minnesota which were taken from the Mississippi River at Minneapolis. They abound in the Lake of the Woods, and are often taken in Lake Superior. On portions of the Lake of the Woods sturgeon fishing is the chief occupation, thousands of large fish being taken annually.

Genus **SCAPHIRHYNCHUS** Heckel.

**Scaphirhynchus platyrhynchus** (Rafinesque). Shovel-nosed Sturgeon. White Sturgeon.

Body rather long, tapering much toward the heterocercal tail; tail flattened from above, continued in a long filament; bony shields with a sharp ridge or keel; dorsal shields 15 to 20 in number; those in the lateral line numbering 41 to 46, and those on the belly or ventral surface 11 to 13. Specimens are often taken which are 5 feet in length. It has been taken in the Minnesota River at Mankato (Cox, 1893); in the Mississippi River at Winona (Holzinger, 1894); in the Mississippi River at Minneapolis (reported by fishermen), and further collection of data will, no doubt, show that it is common, especially in the tributaries of the Mississippi.

Order **RHOMBOGANOIDEA.**Family **LEPISOSTEIDÆ.** The Gar-fishes.

Body slender, cylindrical, covered with diamond-shaped scales which are very evenly distributed over the body; jaws long and set with sharp, prominent teeth; upper jaw longest; vomer and palatines covered with teeth; tongue toothless; nostrils near the end of the snout; air-bladder somewhat lung-like and joined by a tube to the œsophagus, thus aiding in respiration. Tail heterocercal; pyloric cæca many. One genus and two species known at present in Minnesota.

Genus **LEPISOSTEUS** Lacépède.**KEY TO THE SPECIES OF LEPISOSTEUS.**

- A. Snout slender and more than twice the length of the head. . . . **osseus.**  
 AA. Snout broad and not much longer than the head, without  
     snout. . . . . **platostomus.**

**Lepisosteus osseus** (Linnaeus). Common Gar-pike Long-nosed Gar. Bill-fish.

Snout more than twice the length of the rest of the head; large teeth of the upper jaw in one row in the adult. Olivaceous on the back and sides and pale below; vertical fins and the posterior part of the body with circular black spots; young with a vertical black stripe. Head contained three times in the length. Dorsal with eight rays. Anal 9. Ventrals 6. Pectorals 10. Lateral line with 62 scales. An interesting fish which reaches a length of five feet, and is found in nearly every lake and stream in Minnesota. Specimens have been recorded from the Mississippi River, Minneapolis (University 1874, 1880); Minnesota River, Ortonville (Woolman & Cox, 1892); Otter Tail River, Breckenridge (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 369), Lake Washington, near Mankato, very common (Cox, 1894).

**Lepisosteus platostomus** Rafinesque. Short-nosed Gar.

Snout equal to or a little longer than the rest of the head; much broader than in the preceding species. General characters much the same as those of *L. osseus*. Head  $3\frac{1}{2}$  in the length. Depth 8. Dorsal with 8 rays. Anal 8. Ventrals 6. Lateral line with an average of 56 scales. When mature, this species reaches a length of 2 to 3 feet. But two specimens have been recorded from the state, and these are in the University Museum. They were taken from the Mississippi at Minneapolis, near the University.

Order **CYCLOGANOIDEA.**Family **AMIIDÆ.** The Bow-fins.

Body stout and covered with heavy, smooth edged scales; head bluntish, bones of the upper portion thick and strong. Mouth rather large, horizontal; jaws with two kinds of teeth, the larger and outer conical; vomer, palatines and pterygoids with small teeth; anterior nostril with a barbel. Dorsal fin very long and not high; tail heterocercal; air-bladder somewhat lung-like and connected with the pharynx; no pyloric caeca. But one species known.

Genus **AMIA** Linnæus.

**Amia calva** Linnæus. Mud-fish. Dog-fish. Bow-fin. "John A. Grindle." Lawyer.

Color, dark olive; sides with dark reticulations; male with a round black spot, which is edged with yellow, on the base of the caudal fin; lower jaw with dark spots. Head  $3\frac{3}{4}$ . Depth 4 to  $4\frac{1}{2}$ . Dorsal with 42 to 53 rays. Anal 10 to 12. Lateral line with 65 to 70 scales. The female reaches a length of two feet, but the male does not exceed eighteen inches. A very common and voracious fish in all the lakes and streams of Minnesota, especially the northern part. Specimens have been recorded as follows: Lakes and streams of the upper Mississippi, very common (Nat. Hist. Surv., 1892-3); Le Sueur River near Mankato (Cox, 1893).

Order **NEMATOGNATHI.**Family **SILURIDÆ.** The Cat fishes.

Body somewhat elongated, and instead of scales, covered with a soft, slimy skin; mouth broad, the upper jaw in front formed by the premaxillaries; teeth numerous, slender and weak and arranged in bands; maxillary ending in a long barbel; six other barbels on the head. In our species, two dorsal fins, the posterior adipose. The dorsal and pectoral fins usually with a stout, sharp spine; air-bladder large. Four genera and ten to twelve species will be found in Minnesota.



## KEY TO THE GENERA OF SILURIDÆ.

- A. Adipose fin conspicuous, its posterior margin free and not continuous with the caudal.
  - B. Teeth on the premaxillaries arranged in a slight curve, the ends of the band not extending back on the sides of the mouth.
    - C. Bones of the head continuous with those at the base of the first dorsal (determined by pressing gently on the upper part of the body between the dorsal fin and the head). Caudal fin deeply forked. (Channel Cat) **Ictalurus**, 16
    - CC. Bones of the head not continuous with those at the base of the first dorsal (determined as in C).
      - (Bull-head) **Ameiurus**, 17
  - BB. Premaxillary band of teeth arranged in horseshoe-shape, the ends extending back on the sides of the mouth; dorsal spine little developed. . . . . (Mudcat) **Leptops**, 19
- AA. Adipose fin continuous with the caudal.
  - B. Band of teeth on the upper jaw with a backward extension on each end. . . . . (Stone Cats) **Noturus**, 19
  - BB. No backward extension at the ends of the band of teeth on the upper jaw. . . . . (Mad Toms) **Schilbeodes**, 19

### Genus **ICTALURUS** Rafinesque.

**Ictalurus punctatus** (Rafinesque). Channel Cat. Silver Cat. White Cat.

Barbels long, color light olive; lighter on the sides; scarcely ever dark like the bull-heads; generally covered with dark, circular spots; body rather slender; spines large, strong and sharp, the pectoral serrate behind; eye large, located about midway between snout and the end of the opercle. Mouth small; head contained four times in the length; depth 5. This fish reaches a length of three feet and a weight of 20 to 25 pounds. It is reported by Mr. Cram as common in the Minnesota River near Mankato each spring. It is no doubt common in all the large streams in the state. It has been taken in the Red River of the North at Moorhead and at Grand Forks (N. D.); in the Otter Tail River at Breckenridge and Red Lake River at Grand Forks (N. D.) and Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).

Genus **AMEIURUS** Rafinesque.**KEY TO THE SPECIES OF AMEIURUS.**

- A. Caudal forked.
  - B. Anal with 25 to 35 rays. . . . . **lacustris**, 17
- AA. Caudal not forked, generally rounded.
  - B. Anal rays, including rudiments, 22 to 27, base of the anal fin more than one-fourth the length of the body. . . . . **natalis**, 17
- BB. Anal rays 15 to 22; base of anal fin contained 4 to 5 times in the body.
  - C. Lower jaw projecting beyond the upper. . . . . **vulgaris**, 18
- CC. Lower jaw not projecting beyond the upper.
  - D. Anal rays more than 20; pectoral spines contained 2 to 2½ times in the head. . . . . **nebulosus**, 18
- DD. Anal rays less than 20 (17 to 19); pectoral spines contained 2½ to 3 times in the head. . . . . **melas**, 18

Genus **AMEIURUS** Rafinesque.

**Ameiurus lacustris** (Walbaum). Great Cat-fish. Great Fork-tailed Cat. Mississippi Cat. Florida Cat. Cat-fish of the Lakes. Flannel-mouthed Cat.

Dark slaty-blue, growing darker with age; interruption between the bones of the head and base of the first dorsal but slight; body more slender than the others of this genus, but somewhat heavier than *Ictalurus punctatus*; head depressed; eye moderate, in front of the middle of the head; barbels long, colored black; caudal fin deeply forked. Head contained four times in the length of the body. Depth 5. Dorsal I, 5 or 6 rays. Pectorals, I, 9. Anal long, with 25 rays. One of the largest fishes, reaching a weight of one hundred pounds or more.

So far I have no definite record of the occurrence of this fish in Minnesota, but as cat-fish of this description have been reported by fishermen and as this state is evidently within its range there is but little doubt that it has been taken in the larger streams, especially in the Mississippi.

**Ameiurus natalis** (Le Sueur). Yellow Cat.

Color varying from yellowish to greenish or blackish; body heavy and short; head short and broad; mouth wide; anal rays 24 to 27; base of the anal fin more than  $\frac{1}{4}$  the length of the body. Length 15 inches. This is considered a very variable fish, and present information indicates that it is not very common in Minnesota. The number of anal rays is the chief characteristic which distinguishes it. Specimens in the University Museum were taken as follows: Lake Johanna, Ramsey Co., and Spirit Lake, Aitkin Co. (Nat. Hist. Surv., 1892); Lake Kilpatrick, near Gull Lake, several reported (Nat. Hist. Surv., 1893).

***Ameiurus vulgaris* (Thompson).**

Lower jaw projecting beyond the upper; color dark brown or even black on the upper parts and sides; lower parts lighter; anal fin with 18 to 22 rays, its base contained 4 to 5 times in the body; lower jaw projecting beyond the upper. Body moderately elongated; head somewhat longer than broad; mouth large and wide; maxillary barbels long; back considerably elevated; head contained  $3\frac{1}{2}$  to 4 times in the length. Pectoral spines contained  $2\frac{1}{4}$  times in the head. Depth contained  $4\frac{1}{2}$  to 5 times in the length. Length 18 inches. This fish is probably common in most of the waters of Minnesota and is distinguished from the others of the genus chiefly by the number of rays in its anal fin and by its projecting lower jaw. Specimens have been taken in Lake Amelia, near Ft. Snelling (Collected by Dr. Geo. D. Suckley and described as *Pimelodus ailurus* by Chas. Girard, U. S. Pac. R. R. Explorations, Fishes, 1858, 210); Lake Minnetonka (C. H. & T. S. Roberts, 1879); Minnehaha Creek, Minneapolis and Fish-hook Lake, Hubbard Co. (Nat. Hist. Surv., 1892).

***Ameiurus nebulosus* (Le Sueur). Common Bull-head. Horned Pout.**

Color varying from yellowish to black; anal fin with 21 to 22 rays, its length contained four times in the body; upper jaw usually longer than the lower; pectoral spine contained 2 to  $2\frac{1}{2}$  times in the head. It reaches a length of 18 inches. Not very common in Minnesota, as far as present observations have gone. It can be distinguished from the following only by its anal fin and the length of its pectoral spines.

Three specimens were taken in the Blue Earth River, Mankato (Cox, 1891); Red River of the North and tributaries, several (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 369).

***Ameiurus melas* (Rafinesque).**

Color usually black; body stout; head flat; anal fin shorter than in the preceding, its rays 17 to 19 and light colored; its length contained five times in the body; jaws about equal; young slender, growing heavier with age.

Very common in all the waters of Minnesota. Specimens have been taken from Basset's Creek, Minneapolis (T. S. Roberts, 1879); Big Stone Lake and the Upper Minnesota River (Woolman & Cox, 1892); lakes and streams of the Upper Mississippi, common (Nat. Hist. Surv., 1892-3); streams and lakes near Mankato, also Southwestern Minnesota (Cox, 1892-5); Lake of the Woods, St. Louis River and Upper Mississippi (Woolman & Cox, 1894).



Genus **LEPTOPS** Rafinesque.**Leptops olivaris** (Rafinesque). Mud Cat. Flat-head Cat. Russian Cat.

Yellowish, mottled with brown; head much depressed; lower jaw longer than the upper; premaxillary band of teeth with backward processes; dorsal spine weak and not ending in a sharp point; anal fin with 12 to 15 rays. A large fish which sometimes reaches a weight of 50 to 75 pounds.

No definite record of its occurrence in Minnesota has been made so far, but it has probably been taken in the Mississippi River and other large streams, as large cat-fish resembling this have been reported by fishermen.

Genus **NOTURUS** Rafinesque.**Noturus flavus** Rafinesque. Stone Cat.

Color uniform yellowish brown; body rather slender; head flat and broad; tail compressed; head contained  $4\frac{1}{4}$  times in the length; barbels short; dorsal spine long; pectoral spine serrate in front, its teeth pointing towards the body. Anal rays 16.

A fish that reaches a length of 12 inches. It is not common in Minnesota so far as known. One specimen has been recorded from the Blue Earth River at Mankato (Cox, 1893). Several were seen in the same river a year later.

Genus **SCHILBEODES** Bleeker.**KEY TO THE SPECIES OF SCHILBEODES.**

- A. Pectoral spine smooth on its posterior edge, but with a longitudinal groove; adipose fin not notched. . . . . **gyrinus**, 19
- AA. Pectoral spine with spines on serræ (serrate) on its posterior edge; adipose fin somewhat notched. . . . . **exilis**, 20

**Schilbeodes gyrinus** (Mitchill).

Adipose fin continuous with the caudal; color varying from yellowish brown to almost black above, darker below; some longitudinal dark streaks. Pectoral spine smooth, but with a long longitudinal groove on the posterior edge, smooth on the anterior edge, contained 2 times in the head; in general, spines stout and rather long. Anal fin with about 13 rays. Length 5 inches.

A fish similar in habits to the *S. exilis*. Quite common in Minnesota, but not generally distinguished from the young of *Ameiurus melas* or *A. nebulosus*. It can be told at once from these by its adipose fin. Specimens are recorded from the streams and lakes of the

Upper Mississippi (Nat. Hist. Surv., 1892-3-5); Pomme de Terre River, Appleton, and Chippewa River, Montevideo (Woolman & Cox, 1892); Red River of the North and tributaries (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 369); Upper Mississippi (Woolman & Cox, 1894).

**Schilbeodes exilis** (Nelson).

Adipose fin continuous with the caudal; color dark brown or blackish; pectoral spine roughish in front, serrate on its posterior edge; head rather small and not much depressed; jaws about equal; dorsal spine not high and inserted midway between the tip of the snout and front of the anal fin. Length four inches. Found in rivers under stones. Either not common or because of its peculiar habits has not been observed. One specimen has been taken in the Blue Earth River at Mankato (Cox, 1893).

## Order **PLECTOSPONDYLI.**

### Family **CATOSTOMIDÆ.** The Suckers.

Body generally elongate, in some species much compressed, while in others heavy and depressed; covered with smooth-edged scales; head scaleless; no barbels; mouth varying in size, but always so constructed that it can be drawn out to a considerable extent, thus enabling the fish to take food from the bottom of the stream or lake. No teeth in the jaws; pharyngeal bones set with numerous teeth which are somewhat similar to a comb. Gill membranes united to the isthmus; dorsal fin contains many soft rays; no spines; caudal fin forked; ventral fins inserted far back on the abdomen; pectoral fins inserted on the lower part of the body. Intestine long; air-bladder large and in two or three parts. Five genera and eleven species are known at present in Minnesota.

### KEY TO THE GENERA OF CATOSTOMIDÆ.

- A. Dorsal fin long, its rays 25 to 50; air-bladder in two parts.
  - B. Top of the skull with a soft spot (fontanelle), (determined by pressing on the part); scales rather large, 34 to 42 in the lateral line.
    - C. Mouth large, terminal, protractile forwards. . . . . **Ictiobus**, 21
    - CC. Mouth small, inferior, protractile downward. . . . . **Carpiodes**, 22
  - BB. Top of the skull without a fontanelle, scales rather small, about 56 in the lateral line. . . . . **Cycleptus**, 23
- AA. Dorsal fins short, its rays 10 to 18.
  - B. Scales small (48 to 100 in the lateral line); air-bladder in two parts; pharyngeal teeth small.
    - (Fine-scaled Suckers) **Catostomus**, 24
  - BB. Scales large (less than 48 in the lateral line); air-bladder in three parts; pharyngeal teeth increasing in size downwards. . . . . (Red-horse) **Moxostoma**, 25

Genus **ICTIOBUS** Rafinesque.**KEY TO THE SPECIES OF ICTIOBUS.**

- A. Mouth large, protractile forwards; lips thin. . . . . **cyprinella.**  
 AA. Mouth smaller, protractile downwards; lips rather thick. . . . . **bubalus.**

**Ictiobus cyprinella** (Cuvier & Valenciennes). Common Buffalo-fish. Red-mouthed Buffalo.

Body heavy, compressed but only moderately so for a buffalo, back much curved; head large and thick; mouth nearly horizontal, large and constructed as to be drawn forward rather than downwards; lips little developed; pharyngeal teeth weak; air-bladder in two parts; opercle coarsely striate and large; color of both body and fins dark; scales large, 7-37 to 41-6. Head contained  $3\frac{1}{2}$  times in the body. Depth 3 in the length. Dorsal fin with 27 to 29 rays. Anal 9. Length 3 feet. A fish which when mature weighs from 20 to 40 pounds. Rather common in the large streams and some of the lakes. A specimen was examined in the hotel at Grand Rapids, Minnesota, in August, 1894, by Woolman & Cox, which had been taken in the vicinity and which weighed thirty pounds; a buffalo which is probably this species was reported very common in Big Stone Lake in 1892. Many interesting reports are heard of the immense numbers of large buffalo that have been seen and taken in Lake Washington near Mankato during the spawning season, and the same report comes from the Okabena lakes at Worthington. Whether the fishes referred to in these reports were *Ictiobus cyprinella* is uncertain, but the probabilities are that they were this species.

Note—The specific characters of the buffalo are as yet rather uncertain, and the number collected in Minnesota so far is quite small, consequently the descriptions given here may need alteration after further collection and study.

**Ictiobus bubalus** (Rafinesque). Sucker-mouthed Buffalo. Small-mouthed Buffalo.

Mouth smaller than in the preceding and capable of being drawn downward rather than forward; body more compressed than in the preceding; back much elevated; head not very blunt; pharyngeal teeth rather strong, increasing in size downward; longest dorsal ray longer than the base of the dorsal fin. Color dark or dusky, but the fins not darker than the body. Eye 4 to 5 in the head. Head 4 in length. Depth  $2\frac{2}{3}$ . Dorsal with 29 rays. Scales 8-39-6. So far as known specimens have been taken only in the Minnesota River at Mankato (Cox, 1892), but it is probably common in the larger streams and possibly some of those referred to under *I. cyprinella* are this species.



Genus **CARPIODES** Rafinesque.**KEY TO THE SPECIES OF CARPIODES.**

- A. Back not greatly elevated, depth about 3 in length; lips thin, the halves of the lower lip meeting at a wide angle. . . . . **carpio**, 22
- AA. Back considerably elevated, depth about  $2\frac{1}{2}$  in length.
  - B. Lips thin, silvery white in life, the halves of the lower lip meeting at a wide angle as in *C. carpio*. . . . . **difformis**, 22
  - BB. Lips thick, reddish in life, the halves of the lower lip meeting at an acute angle. . . . . **velifer** 23

**Carpiodes carpio** (Rafinesque). Carp Sucker.

Lower pharyngeal bones narrow, the teeth weak. Coloration, light silvery, sometimes brassy, some scales occasionally brownish at the base. Back compressed and not so much elevated as in the preceding species; head rather short, contained 4 to 5 times in the length of the body; first rays of the dorsal fin short, longest rays  $\frac{2}{3}$  to 3-5 the length of the dorsal, never extended in long filaments, thickened at the base so as to be quite stiff in the adult; front of dorsal fin nearer the snout than the base of the caudal; caudal fin forked; snout a little longer than the width of the eye, not projecting far beyond the mouth. Eye  $4\frac{1}{2}$  to 5 in the head. Head 4 in length. Depth 3. Dorsal fin with 25 to 30 rays. Scales 7-37-5.

Many small specimens were taken in the Minnesota River at Ortonville which are thought to be this species (Woolman & Cox, 1892); a specimen in the University Museum was taken from the Mississippi River at Minneapolis (Nat. Hist. Surv., 1893). Further collections will probably prove it to be common, especially in the streams of the Mississippi system.

**Carpiodes difformis** Cope.

Snout very blunt, the front of the lower jaw about even with the front of the eye socket, the maxillary bone extending back to the anterior edge of the eye; nostrils inserted very near the tip of the snout; eye large, contained  $3\frac{1}{2}$  to 4 times in the head. Lower lip  $\lambda$ -shaped below. Head contained in the length  $4\frac{1}{2}$  times. The back considerably elevated and the depth less than half the length. Scales 6-35-4. Dorsal fin very high and averaging 24 rays, its first ray inserted nearer the snout than the base of the caudal fin.

Not common in Minnesota and further study and collections are needed to determine its distribution. Several small specimens have been taken in the Blue Earth River at Mankato (Cox, 1892).

**Carpiodes velifer** (Rafinesque). Quill-back. Spear-fish. Skim-back. River Carp.

Body much arched above. First rays of the dorsal fin long and filamentous, often as long as the base of the fin; snout conical projecting beyond the mouth, obtusely pointed, anterior nostril behind the front of the upper lip, farther from the tip of the snout than half the diameter of the eye; lower lip  $\Lambda$ -shaped below.

Coloration generally bright; eye moderate, contained four to five times in the head. Head  $3\frac{3}{4}$  to 4. Depth  $2\frac{1}{2}$  to 3. Dorsal with 26 rays. Scales 7-35-5.

Several specimens have been taken from the Minnesota and Blue Earth Rivers at Mankato (Cox, 1892-3). Pomme de Terre River, Appleton, abundant (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 356).

#### Genus **CYCLEPTUS** Rafinesque.

**Cycleptus elongatus** (Le Sueur). Black Horse. Gourd-seed Sucker. Missouri Sucker.

Head very small and slender; eye small and located well back from the tip of the snout; mouth entirely inferior and small; snout projecting beyond the mouth; the upper lip thick, covered with 3 to 5 rows of tubercles; the lower lip of moderate size. Pharyngeal teeth well developed and increasing in size downward, not very close to each other. Body rather long and not compressed for fishes of this genus; back not greatly elevated. Head contained 6 to  $8\frac{1}{2}$  times in the length, covered with tubercles in the spring males. Depth contained 4 to 5 times in the length. Scales 55 to 60 in the lateral line, which is nearly straight and well developed. Seventeen rows between the dorsal and ventral fins. Dorsal fin with 30 rays. Anal 7 or 8. Eye small, contained 6 or 7 times in the head. Length  $2\frac{1}{2}$  feet.

Probably common in the streams of the Mississippi system, but the only record of its occurrence in the state is in the museum catalogue of the University of Minnesota where a specimen is recorded as having been taken by W. H. Chambers at Minneapolis, May 15, 1880. Some of the specimens in the museum were destroyed by fire in December, 1889, and this was, no doubt, among them, as it cannot now be found. It should be looked for in collections from the Mississippi River.

Genus **CATOSTOMUS** Le Sueur.**KEY TO THE SPECIES OF CATOSTOMUS.**

- A. Scales very small, about 100 in lateral line. . . . **catostomus**, 24  
 AA. Scales about 65 in the lateral line. . . . **commersonii**, 24  
 AAA. Scales 48 to 55 in the lateral line. . . . **nigricans**, 25

**Catostomus catostomus** (Forster). Northern Sucker. Long-nosed Sucker.

Body long and slender; head also long and slender, flat above; a long and tapering snout which overhangs the large mouth; upper lip thin with two to four rows of papillæ; anterior edge of lower jaw rather hard; eye small and inserted back of the middle of the head. Scales small, 95 to 114 in the lateral line. Dorsal with 10 or 11 rays. Head contained  $4\frac{1}{4}$  to  $4\frac{2}{3}$  times in the length. Depth  $4\frac{1}{4}$  to  $4\frac{3}{4}$  in the length.

The spring males have the head and anal fin covered with tubercles and a rosy lateral band.

This is probably a common fish in the streams and lakes of the northern part of the state, but at present it is known only from the mouth of Rapid River, a southern tributary of the Rainy River from the Red Lake Indian Reservation, where it is quite common (Woolman & Cox, 1894).

**Catostomus commersonii** (Lacépède). Black Sucker. Common Sucker. Fine Scaled Sucker.

Color very variable, being sometimes quite dark, hence giving rise to the name, black sucker, and again specimens will be found that are quite light, and in certain localities these are termed white suckers; generally dark olivaceous on the back, lighter below, males rose tinted on the sides in spring. Head large; snout conical, extending but little beyond the mouth; mouth large, the lips covered with papillæ; scales small, smaller forward, 10-64 to 70-9. Head contained 4 to  $4\frac{1}{4}$  times in the length. Depth  $4\frac{1}{4}$ . Dorsal with 12 rays. Length when mature 18 inches.

Common in all our lakes and streams. Specimens have been recorded from Vermillion Lake, St. Louis Co. (Nat. Hist. Surv., 1891); the stream and lakes in the vicinity of Mankato and Southwestern Minnesota (Cox, 1891-5); Big Stone Lake, Upper Minnesota River and tributaries (Woolman & Cox, 1892); Mantrap Lake, Upper Mississippi River from its source to Grand Rapids, with its tributaries; Gull Lake and tributaries; Mille Laes and tributaries (Nat. Hist. Surv., 1892-3-5); Lake of the Woods, Lake Superior, St. Louis Rivers and Upper Mississippi, in the region of the Deer River and Grand Rapids (Woolman & Cox, 1894).



**Catostomus nigricans** Le Sueur. Hog Sucker. Stone Roller. Stone Lugger. Stone Toter. Hammer Head. Crawl-a-bottom. Hog Molly. Hog Mullet.

Back with several dark, irregular cross-blotches; lower parts white; lower fin sometimes tinged with red; young more mottled than the adult. Head large and flattened above; lips thick and large, papillæ numerous. Dorsal with 10 to 11 rays. Pectoral fins very large. Scales small, 48 to 55 in the lateral line. Length 2 feet.

Probably common in Minnesota, but so far it has been noted only in the Minnesota and Blue Earth rivers at Mankato (Cox, 1892-3), where it is very common. The writer once saw a school of several hundred quite large ones in the Blue Earth River at the above place. The young resemble very much those of the *C. commersonii*, but can be distinguished from them by the smaller number of scales in the lateral line, the mouth and head, and the mottled markings.

Genus **MOXOSTOMA** Rafinesque.

### KEY TO THE SPECIES OF MOXOSTOMA.

- A. Dorsal fin large, 15 to 18 developed rays. . . . . **anisurum.**  
 AA. Dorsal fin smaller, 12 to 14 developed rays. . . . . **aureolum.**

**Moxostoma anisurum** (Rafinesque). White-nosed Sucker.

Color somewhat lighter than the following; body rather heavy, compressed; lips rather thin; the two edges of the lower lip forming an  $\Lambda$ -shaped angle where they come together. Dorsal fin large, its rays 15 to 18, free edge straight, the first ray equaling the length of fin. Upper lobe of the caudal longer than the lower. It can be distinguished from the following by the caudal and dorsal fins.

Not common in Minnesota. One specimen has been taken from the Des Moines River at Windom (Cox, 1894).

**Moxostoma aureolum** (Le Sueur). Red Horse. Mullet. White Sucker.  
 Large Scaled Sucker.

Olivaceous on the back, shading to silvery on the sides, lower fins red in the adult; head flattened above; mouth large; lips thick; eye large. Dorsal fin with 12 to 14 rays, its edge nearly straight and its first ray shorter than the head. Anal with seven rays. Scales large, 5-45-4. Head contained 4 to 5 times in the length of the body. Length 2 feet.

Very common in the lakes and rivers of Minnesota. Specimens have been recorded from the lakes and streams of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5; Woolman & Cox, 1894); lakes

and streams in the vicinity of Mankato and in Southwestern Minn. (Cox, 1891-5); Big Stone Lake and the Upper Minnesota River and tributaries (Woolman & Cox, 1892); Red River of the North and tributaries (Woolman, 1892, Report U. S. Fish Comm., 1893); Lake of the Woods and tributaries (Woolman & Cox, 1894).

Family **CYPRINIDÆ**. The Minnows.

Head scaleless, lips thin, mouth never sucker-like. Anal fin short; dorsal with not more than ten rays; ventral fins inserted far back on the abdomen, jaws toothless; sometimes 2 to 4 barbels, but these generally absent. Pharyngeal teeth well developed and important in noting specific characters, the number of pharyngeal teeth small, arranged in one or two rows; no adipose fin; air-bladder usually large and in two parts.

Nearly all fishes of small size, the number of species being very large and difficult to determine, owing to their likeness in structure, color and other characters. In the spring the males of many species assume rich colors which they do not have at other times; their snouts become covered with tubercles and, in some species, more blunt and are thus so disguised that they are thought by many fishermen to be different species. Every collector has listened to the description of some "peculiar" fish which is said to have been found but once or twice in the given region, and then only in spring time, which fish usually proves to be none other than the common "Blunt-nosed Minnow," *Pimephales notatus*, which was arrayed in its breeding costume. The cultivated Carp (*Cyprinus carpio* Linnæus) and the Gold-fish (*Carassius auratus* Linnæus), both of which have been introduced from Europe, belong to this family.

## KEY TO THE GENERA OF CYPRINIDÆ.

- A. Intestine *very* long and wound many times around the air-bladder. . . . . **Campostoma**, 28
- AA. Intestine not wound around the air-bladder; air-bladder in the upper portion of the abdominal cavity.
  - B. Digestive canal long, usually more than twice the length of the body; inside coat of the abdominal wall usually black; pharyngeal teeth one rowed, the grinding surface well developed.
    - C. Pharyngeal teeth 5-5 or 4-5; dorsal fin inserted behind the ventrals; scales very small; lateral line incomplete. **Chrosomus**, 28
    - CC. Pharyngeal teeth 4-4; dorsal fin inserted over the ventrals; scales rather large.
      - D. Less than 15 scales before the dorsal fin; the first (rudimentary) ray of the dorsal fin firmly joined to the next. . . . . **Hybognathus**, 28
      - DD. More than 20 scales before the dorsal fin; first ray of the dorsal blunt and not firmly joined to the second but connected with it by a membrane. **Pimephales**, 29
  - BB. Digestive canal short, less than twice the length of the body; inside coat of the abdominal wall generally of pale coloration.
    - C. Pharyngeal teeth in the main row 5-5 or 4-5.
      - D. Abdomen behind the ventral fins not compressed into a sharp edge but rounded, the scales passing over it.
        - E. Maxillary bones ending in a small barbel; premaxillaries protractile. . . . **Semotilus**, 30
      - EE. Maxillary without a barbel; pharyngeal teeth two rowed and usually two teeth in the inner row, teeth strongly hooked; scales small. . . . . **Leuciscus**, 30
    - DD. Abdomen compressed to a sharp ridge so that the scales do not pass over it; rays in the anal fin 12 to 18; lateral line much decurved. . . . **Abramis**, 32
    - CC. Pharyngeal teeth in the main row 4-4.
      - D. Maxillary bone not ending in a barbel; upper jaw protractile; scales large, 30-50. . . . **Notropis**, 33
      - DD. Maxillary with a barbel, though small.
        - E. Scales small, 60 or more in the lateral line, premaxillaries not protractile; teeth 2, 4-4, 2. **Rhinichthys**, 38
        - EE. Scales large, 35 to 55; premaxillaries protractile, teeth 4-4 or 1, 4-4, 1 or 0. . . . **Hybopsis**, 40



Genus **CAMPOSTOMA** Agassiz.

**Campostoma anomalum** (Rafinesque). Stone Roller. Stone Lugger. Steel-backed Chub. Mammy. Dough-belly.

Color brownish with a slight yellowish luster; scales mottled with brown; a dark bar behind the opercles; a dark bar across the dorsal and anal fins, the remainder of these fins bright red in the spring males. The most characteristic point about this fish is the great length and peculiar arrangement of the intestines, which is wound many times around the air-bladder. It needs but one peep at the internal anatomy of this fish to determine its genus. Snout somewhat decurved; scales small and crowded forward, 7-53-8. Dorsal fin with 8 rays. Anal 7. Teeth 4-4. Length 4 to 8 inches. Not very common in Minnesota. Specimens have been taken in the Minnesota and Blue Earth rivers at Mankato, where it is quite common (Cox, 1891-5); Pomme de Terre river at Appleton (Woolman & Cox, 1892).

Genus **CHROSOMUS** Rafinesque.

**Chrosomus erythrogaster** Rafinesque. Red-bellied Dace.

Body not much compressed, oblong, largest in the middle and tapering towards each end. Head somewhat pointed; mouth terminal, oblique, jaws equal or about so. Fins not large, the dorsal and anal high and short. General color brownish olive; a dark dorsal line and sometimes black spots; two dark bands on each side with a silvery band between them; a black spot at the base of the caudal fin; belly silvery; spring males with the belly, space between the dark lateral bands and the bases of the vertical fins scarlet; occasionally the body is covered with tubercles and the fins are bright yellow; females not so conspicuously marked. Head 4 in length. Depth 4. Dorsal rays 7. Anal 8. Scales small, 16-85-10, not overlapping much. Pharyngeal teeth usually 5-5. Length 2 to 3 inches. Not common in Minnesota so far as known. It has been reported as rare at Austin by Dr. S. E. Meek (Bull. U. S. Fish Comm. X, 1890, p. 233).

Genus **HYBOGNATHUS** Agassiz.

**Hybognathus nuchalis** Agassiz. Silvery Minnow.

Intestine long, 7 to 10 times the length of the body. Color silvery with bright reflections, darker above; color varies greatly with the conditions. Body rather slender; head rather short;

lateral line decurved. Head contained  $4\frac{1}{2}$  to 5 times in the length of the body. Eye 4 in head. Dorsal fin with 8 rays. Anal 7. Scales large, 5-38-4. Length 4 to 7 inches. This fish can always be distinguished by its long intestine, if not from its general appearance. It is probably common in the southern part of the state but rare in the northern part. Specimens have been taken at several places on the Upper Mississippi and in Minnehaha Creek, Minneapolis, rare (Nat. Hist. Surv., 1892-3-5); in the streams and lakes in the vicinity of Mankato, common (Cox, 1891-5).

Genus **PIMEPHALES** Rafinesque.

### KEY TO THE SPECIES OF PIMEPHALES.

- A. Lateral line generally incomplete; body short. . . . . **promelas.**  
 AA. Lateral line complete; body more elongate. . . . . **notatus.**

**Pimephales promelas** Rafinesque. Flat-head. Black-headed Minnow.

First ray of the dorsal fin large and blunt in the adult males. Intestine long, more than twice the length of the body; teeth 4-4; lateral line incomplete or wanting. Body rather short and heavy; head short, contained 4 times in the length of the body, much rounded in the adult male; mouth small. Color of the immature and females, olivaceous; dorsal fin with a black bar across it, this not very distinct in the young. Mature males vary from bluish to black in color; snout with tubercles. Dorsal rays I, 8. Anal 7. Scales 7-43 to 47-6. Length  $2\frac{1}{2}$  inches. Common everywhere in both lakes and streams. Specimens have been recorded from almost every lake and stream in the state where collections have been made, and it is so common that specific notes on its distribution are here omitted. It is often found with the next.

**Pimephales notatus** (Rafinesque). Blunt-nosed Minnow.

First ray of the dorsal fin distinct and spine-like in the adult male; intestine, teeth and snout same as in *P. promelas*. Lateral line complete. Body slightly elongate; head moderate, top depressed, mouth small. Fins small. Color olivaceous, sides bluish, a black spot on the front of the base of the dorsal fin; the base of the caudal dusky; the fins sometimes tinged with red. Adult male in the breeding season with very much more black and with tubercles on the black, round snout. Head  $4\frac{1}{2}$ . Dorsal rays I, 8. Anal 7. Scales 6-45-4. Teeth 4-4. Length 4 inches. Abundant in Minnesota and often found with *P. promelas*. Specimens have been recorded from all parts of the state where collections have been made. Very common, especially in small brooks and pools.

Genus **SEMOTILUS** Rafinesque.

**Semotilus atromaculatus** (Mitchill). Horned-dace. Creek Chub.

Body rather stout; head large; mouth large and broad, oblique; generally a small barbel on the maxillary in mature specimens, not distinguishable in small specimens. Color dark above, sides with a black lateral band in the young, this disappearing with age; under parts yellowish, tinged with red in the spring males; dorsal fin small, with a black spot at its base in front, edged with red in the male in the breeding seasons; a dark bar behind the opercles; scales edged with dark dots; young with a small dark caudal spot; snout in the males covered with tubercles in the spring. Scales fine, 9-55-6, averaging 55 in the lateral line but varying from 50 to 60; 30 scales before the dorsal fin. Pharyngeal teeth 2, 5-4, 2. Head contained  $3\frac{3}{4}$  times in the length. Eye 5 in the head. Dorsal fin inserted behind the ventrals, contains 7 rays. Anal 8. Length 10 inches.

A very common minnow in Minnesota. It has been taken at every place where collections have been made.

Genus **LEUCISCUS** Cuvier.

**Leuciscus nachtriebi** Cox.\*

Body rather heavy, not greatly compressed; back slightly elevated, its curve a little greater than that of the belly; caudal peduncle rather stout, its depth  $\frac{1}{2}$  the length of the head. Head rather short, not any more compressed than the body, upper surface slightly flattened; snout quite blunt in mature specimens, its length 1 1-6 times the width of the eye; mouth not very large, but little oblique, lower jaw included, maxillary scarcely reaching to the front of the orbit of the eye; eye small, contained 4 times in the length of the head; pharyngeal teeth 2, 4-5, 2. Dorsal fin with 8 rays, its first rays inserted nearer the base of the caudal than the tip of the snout, also slightly back of the ventrals; caudal fin forked; anal with 8 rays, slightly smaller than the dorsal; ventrals small, not reaching the vent by  $\frac{1}{3}$  their length; pectorals inserted rather high, not reaching the ventrals by  $\frac{3}{4}$  their length. Scales small, 12-72-9, lateral line complete on mature specimens, decurved, the pores extending on the head in several lines, one passing back

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\*Since the following description of this new species was written it was found that there would be considerable delay in the publication of the present report, consequently the description was printed in the report of the U. S. Fish Comm. for 1894, p. 605. (Dec. 14, 1896.)



of the eye, another down to the nostril. General color dusky, darkest on the back; the sides above the lateral line dull silvery, below the lateral line light silvery; a faint dark dorsal band in some specimens, in others absent; no black lateral band but some specimens have a very faint dusky shade along the lateral line; no light stripe above the lateral line; upper portion of the opercles with a dusky shade, lower part bright silvery; upper part of the head dark colored; a faint rose colored lateral band generally present in fresh specimens; all the above colors typical in the young as well as the adult. Head contained  $4\frac{1}{8}$  ( $4$  to  $4\frac{1}{2}$ ) times in the length of the body. Depth  $5$  ( $4\frac{1}{8}$  to  $5\frac{1}{2}$ ). Length 4 inches.

*L. nachtriebi* differs from *L. neogaeus* in having a well developed lateral line, a smaller eye, fewer scales, less oblique mouth, a shorter maxillary and in being a larger fish and differently colored. It differs from *L. elongatus*, a species which might occur in the state, in having a smaller mouth, the lower jaw never projecting, head less pointed, a shorter maxillary, finer scales and the absence of the black lateral band. The accompanying tabulated measurements will give some idea of the variation of the species.

At present this fish is known from but two localities, viz., Mille Lacs Lake, Atkin County, where several specimens were taken by the Nat. Hist. Surv. in 1892, and in Man Trap, Mud and Elbow Lakes in the region of Park Rapids, Hubbard County, where several specimens were taken by the Nat. Hist. Surv. in 1893. In all, about 40 specimens have been taken, several of which were tagged and examined by Mr. F. B. Sumner, then of the University, who was in charge of the survey party that took these fish and who, himself, thought that they were new, but did not describe them. The species is named for Prof. Henry F. Nachtrieb, State Zoölogist of Minnesota.

| Tag. | Length.<br>(inches.) | Head.           | Depth.          | Dorsal Fin. | Anal Fin. | Scales.  | LATERAL LINE.                    |                                   |
|------|----------------------|-----------------|-----------------|-------------|-----------|----------|----------------------------------|-----------------------------------|
|      |                      |                 |                 |             |           |          | RIGHT.                           | LEFT.                             |
| *4   | 33 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 5               | x           | x         | 12-75-9  | Complete .....                   | Complete.                         |
| 5    | 35 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 4 $\frac{7}{8}$ | x           | x         | 12-72-9  | Complete .....                   | Complete except about 6 scales    |
| 6    | 31 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 5               | x           | x         | 12-73-9  | Complete .....                   | Complete.                         |
| 7    | 33 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 5               | x           | x         | 12-72-9  | Complete except 3 or 4 scales    | Complete.                         |
| 8    | 31 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 4 $\frac{7}{8}$ | x           | x         | 13-74-9  | Complete .....                   | Complete except 3 or 4 scales.    |
| 9    | 31 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 5               | x           | x         | 11-74-9  | Complete except 3 or 4 scales    | Complete.                         |
| 10   | 3                    | 4 $\frac{1}{2}$ | 5               | x           | x         | 12-76-10 | Complete .....                   | Complete except 3 or 4 scales.    |
| 11   | 31 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 5               | x           | x         | 12-72-9  | Complete .....                   | Complete.                         |
| 12   | 4                    | 4 $\frac{1}{2}$ | 5               | x           | x         | 12-79-9  | Complete .....                   | Complete.                         |
| 13   | 31 $\frac{1}{8}$     | 4 $\frac{1}{2}$ | 5 $\frac{1}{2}$ | x           | x         | 12-74-9  | Complete .....                   | Complete.                         |
| 14   | 23 $\frac{1}{2}$     | 4               | 4 $\frac{3}{4}$ | x           | x         | 12-72-9  | Complete .....                   | Complete.                         |
| 15   | 21 $\frac{1}{4}$     | 4               | 4 $\frac{3}{4}$ | x           | x         | 12-71-9  | Complete .....                   | Complete.                         |
| 16   | 25-16                | 4 $\frac{1}{8}$ | 4 $\frac{3}{4}$ | x           | x         | 12-71-9  | Complete .....                   | Complete.                         |
| 17   | 21 $\frac{1}{4}$     | 4               | 4 $\frac{3}{4}$ | x           | x         | 12-72-9  | Complete .....                   | Complete.                         |
| 18   | 23-16                | 4 $\frac{1}{8}$ | 5               | x           | x         | 12-71-9  | Complete except 3 or 4 scales    | Complete except last few scales.  |
| 19   | 21 $\frac{1}{4}$     | 4               | 5               | x           | x         | 12-71-8  | Complete exc. last 3 or 4 scales | Complete exc. last 3 or 4 scales. |
| 20   | 21 $\frac{1}{4}$     | 4               | 4 $\frac{7}{8}$ | x           | x         | 12-74-9  | Nearly complete .....            | Nearly complete.                  |
| 21   | 21 $\frac{1}{4}$     | 4 $\frac{1}{8}$ | 5               | x           | x         | 12-71-8  | Complete .....                   | Complete.                         |
| 22   | 21 $\frac{1}{4}$     | 4 $\frac{1}{8}$ | 5               | x           | x         | 12-72-8  | Complete .....                   | Complete except 30 scales.        |

\*Co-type in Leland Stanford, Jr., University Museum.

†Type 47688, United States National Museum.

Eight specimens 1 $\frac{1}{8}$  inches in length from the same locality as numbers 14 to 22 are similar in color and other characters, but the lateral line is entirely absent. Some of the pores are developed on the head. Numbers 4 to 11, inclusive, are from Mille Lacs lake, Aitkin county, and numbers 12 to 22 are from Mud and Elbow lakes, Hubbard county.

All specimens excepting those tagged 4 and 7 are in the museum of the University of Minnesota.

### Genus **ABRAMIS** Cuvier.

**Abramis crysoleucas** (Mitchill). Golden Shiner. Bream.

Body much compressed, rather long; lateral line much decurved. Color greenish above; sides, belly and fins yellowish, sometimes with golden reflections. Head short, compressed; mouth small, oblique. Eye contained 3 to 4 times in the head. Head 4 $\frac{1}{2}$ . Depth 3. Dorsal 8. Anal 12 to 14, averaging 13. Scales 10-46 to 51-3. Teeth 5-5. A very pretty fish and quite common; generally small, but may reach a length of 12 inches. Found in quiet waters where there is aquatic vegetation.

Specimens have been taken from the lakes and streams of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); lakes and streams in the southern and southwestern part of the state (Cox, 1891-5); Upper Minnesota River at Ortonville (Woolman, 1892, Report, U. S. Fish Comm., 1893). Common in the southern part of the state, rare in the northern part.

Genus **NOTROPIS** Rafinesque.**KEY TO THE SPECIES OF NOTROPIS.**

- A. Pharyngeal teeth 4-4; 1, 4-4, 0; or 1, 4-4, 1; rarely two teeth in one or both of the inner rows.
  - B. Scales not closely overlapping each other, their exposed surface not wider than long; no black spot on the dorsal fin.
    - C. Pharyngeal teeth generally one rowed, 4-4; rarely 2, 4-4, 2 in *N. heterodon*.
      - D. Lateral line usually more or less incomplete, not always so; a dark lateral band usually present. Small fishes.
        - E. Snout blunt; lower jaw not projecting beyond the upper; mouth small; chin black. **anogenus**, 34
        - EE. Snout pointed; lower jaw projecting.
          - F. Chin not black; mouth very small. **cayuga**, 34
          - FF. Chin black, mouth moderate. **heterodon**, 34
      - DD. Lateral line always complete and with less than 40 scales; teeth 4-4, well hooked; 12 to 15 scales before the dorsal; no spot at the base of the caudal fin. **blennius**, 35
    - CC. Black spot on the base of the caudal fin; pharyngeal teeth two rowed, 1, 4-4, 0; 1, 4-4, 1; or 1 or 2, 4-4, 1 or 2. Head short, contained 4 to 5 times in the body; large for minnows. **hudsonius**, 35
  - BB. Scales closely overlapping each other, their exposed surfaces broader than long, especially on the sides of the body; body considerably compressed; a black blotch on the posterior rays of the dorsal fin in adult specimens. **whiplii**, 36
- AA. Pharyngeal teeth 2, 4-4, 2.
  - B. Anal fins short, with 7 to 9 developed rays.
    - C. Scales closely overlapping each other, the exposed surfaces much broader than long; grinding surface of the teeth developed; individuals reaching 5 to 8 inches in length when mature. **cornutus**, 36
    - CC. Scales not closely overlapping each other; pharyngeal teeth without the grinding surface developed; species of small size. **jejunus**, 37
  - BB. Anal fin long with 11 to 12 rays; dorsal inserted behind the ventrals; parts sometimes colored red.
    - C. No black spot at the base of the caudal fin; scales not closely overlapping each other; usually 5 to 7 scales above the lateral line; fins often with red. **atherinoides**, 37; **dilectus**, 37; **rubrifrons**, 38
    - CC. Usually a dark spot on the dorsal fin; scales above the lateral line 7 to 10; scales closely overlapping each other, their exposed surfaces broader than long; a black spot at the base of the dorsal fin. **umbratilis**, 38



**Notropis anogenus** Forbes.

Lateral line usually complete; body rather stout; mouth very small and very oblique; lower jaw not projecting; snout very blunt, shorter than the eye. Color dark; a dark band on the sides, which passes through the eye; a small dark spot at the base of the caudal fin; a row of black dots along the upper side of the lateral line; chin black. Head contained  $4\frac{1}{2}$  times in the length of the body. Depth 4-5. Eye  $3\frac{1}{4}$ . Dorsal fin with 8 rays. Anal 7. Lateral line with 34 to 37 scales, 13 scales before the dorsal fin. Teeth 4-4. A fish similar to the *N. heterodon*. Probably rare in this state. The only record of its occurrence, so far, is given in Dr. Seth E. Meek's Report of the Fishes of Iowa (Bull. U. S. Fish Comm., X, 1890, p. 232), where it is listed from the Cedar River at Austin, Minn., as rare.

**Notropis cayuga** Meek.

Body slender, a black stripe around the snout, through the eye, along the sides of the body and ending in a small dark caudal spot; the stripe on the sides generally broken at regular intervals, making it appear as so many dark spots; chin not black. Eye large, about equal to the snout; jaws equal; lateral line absent on some scales. Head 4-6. Depth  $4\frac{1}{2}$ . Eye  $3\frac{1}{2}$ . Thirty-six scales in the lateral line, 14 before the dorsal. Teeth 4-4. Length  $2\frac{1}{2}$  inches.

Very common in the southern part of the state, not so common in the northern portion. It has been recorded from the majority of the lakes and streams of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); streams and lakes in the vicinity of Mankato and southwest (Cox, 1891-5).

**Notropis heterodon** (Cope).

The chin black; a black dorsal band; sides with a dark band; general color olivaceous. Body rather stout, back a little elevated; head and snout pointed; mouth oblique, the lower jaw projecting. Head 4. Depth 4. Eye 3. Dorsal with 8 rays. Anal 8. Scales 5-36-3; lateral line usually not complete; 13 scales before the dorsal fin. Teeth 4-4, occasionally 2, 4-4, 2. Length  $2\frac{1}{2}$  inches.

This fish is not believed to be common in Minnesota. It is reported from the Pomme de Terre River at Appleton (Woolman, 1892, Report, U. S. Fish Comm., 1893), but its resemblance to some of the other Cyprinidae, notably *Pimephales promelas*, makes its identification difficult. Further collections are necessary to ascertain its distribution.

**Notropis bleinnius** (Girard). Straw-colored Minnow.

Body little compressed, rather stout, head rather broad and rounded; mouth small, inferior, horizontal; 15 scales before the dorsal fin; dorsal low, its longest ray  $\frac{3}{4}$  the head. Color pale olivaceous, usually a dark dorsal band and a small dark spot in front of the dorsal fin. No caudal spot. Fins unmarked. Head 4. Depth 5. Eye 3. Scales 5-32 to 38-4, averaging 36 in the lateral line. Teeth 4-4. A small fish, 2 to  $2\frac{1}{2}$  inches in length.

Common in all the streams and lakes. Specimens have been taken in great abundance in all places where collecting has been done. If any more abundant in one place than in another it is in the northern part of the state.

**Notropis hudsonius** (De Witt Clinton). Spawn-eater. Spot-tailed Minnow. Shiner.

A distinct black spot at the base of the caudal; a silvery band on the sides; general color varying from yellowish to quite dusky, the nature of the water seeming to determine, to some extent, the color of this minnow. Body rather stout, snout blunt and decurved; length of the snout less than the large eye; mouth horizontal, jaws equal; 18 scales in front of dorsal fin; lateral line nearly straight except just back of the head where it is somewhat decurved. Pectoral fins not extending to the ventrals, ventrals not reaching the vent. Head  $4\frac{3}{4}$ . Depth 4. Eye 3. Dorsal 8. Scales 5-39-4. Teeth 1, 4-4, 0 or 1 or 2. Length 4 to 6 inches. Quite common in Minnesota, but a small fish, often a very great difference in color. A fish which is now considered to be this species was described as *Notropis scopifer* by Eigenmann & Eigenmann, Amer. Naturalist, Feb., XVII., 153, 1893, from Winnipeg. It is quite common in this state, specimens having been taken from many places on the Upper Mississippi; both lakes and streams (Nat. Hist. Surv., 1892-3-5); in the Red River and tributaries (Woolman, 1892, Report U. S. Fish Comm., 1893); Upper Minnesota River and Big Stone Lake (Woolman & Cox, 1892); streams and lakes in the vicinity of Mankato and southwest (Cox, 1894). Specimens taken from a creek flowing into Lake Washington, near Mankato, are very different. Their color is very dark; no yellow present. In appearance they seem to be a different fish, but structurally they are, no doubt, the same.

**Notropis hudsonius selene** (Jordan).

This variety differs from the typical *N. hudsonius* by having a shorter head, 4 4-5; a more oblique mouth; the maxillary reaching the eye; snout 3-5 the eye. Teeth 2, 4-4, 2 or 1. It is referred to in

Jordan & Evermann's Fishes of North and Middle America, I, 269, as being the representative of this species in Lake Superior. Specimens collected in Lake Superior at Bayfield, Wisconsin, by Coll. Milner were described by Dr. Jordan as *Luxilus selene*, Bull. U. S. Nat. Mus., X, 60, 1877. Collections from the Lake Superior region need careful study.

**Notropis whipplii** (Girard). Silver fin.

Color silvery but rather dark, males bluish; scales edged with dark; a black spot on the posterior portion of the dorsal fin; lower parts of the body and fins in the males covered with a white pigment in the breeding season, head and snout often covered with tubercles. Body considerably compressed; back somewhat elevated; arch of the back about equal to that of the belly; head short; mouth small and oblique; lower jaw not projecting when closed. Head  $4\frac{1}{4}$ . Depth 4 in the adult, varying in the young, the latter more slender. Eye  $4\frac{1}{2}$  in the head. Dorsal fin with 8 rays. Anal 3. Scales 5-38 to 40-3. Pharyngeal teeth 1, 4-4-1, their edges serrate. Length 4 inches. Rather common in the state. Numerous specimens have been taken from the lakes and streams of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); from the Minnesota and Blue Earth Rivers at Mankato (Cox, 1891-5); from the Chippewa River at Montevideo (Woolman, 1892, Report U. S. Fish Comm., 1893).

**Notropis cornutus** (Mitchill). Shiner. Red-fin. Dace.

Scales so crowded that their exposed surfaces are very much broader than long, especially on the sides; scales drop off easily; lateral line decurved. Body varies considerably with age, the young being more slender and less compressed than the adult; head rather heavy and compressed, mouth and eyes moderate. Color dark bluish above, very dark in spring males whose snouts are also covered with tubercles; sides and belly silvery, a dark stripe on the back; spring males with the lower fins, sides and belly rosy. Head  $4\frac{1}{2}$  in length. Eye 4 to 5 in the head. Dorsal with 8 rays. Anal 9. Scales 6-41-3, averaging 23 in front of the dorsal, but may vary from 15 to 40. Teeth 2, 4-4, 2. Length 5 to 8 inches.

This is one of our most widely distributed species of fish. Specimens have been taken wherever collections have been made, and it will likely be found in every important lake and stream in the state.

**Notropis cornutus frontalis** (Agassiz).

This variety differs from the typical *N. cornutus* in having a larger head and fewer scales, 18, before the dorsal fin. It is doubt-



ful whether there is enough difference to justify the variety, but it is so listed in Jordan & Evermann's Fishes of North and Middle America, I, 283, and Agassiz described the same from Lake Superior as *Leuciscus frontalis* and *gracilis*, Lake Superior, 368, 370, 1850.

**Notropis jejunus** (Forbes).

Color pale, a broad, silvery lateral band which is shaded with dusky colors; dorsal fin sometimes dotted with black. Body slender, head flattened above, snout rounded, mouth large and obliquely set; 16 scales before the dorsal, which is inserted over the ventrals. Head contained 4 times in the body. Depth  $4\frac{2}{3}$ . Eye  $3\frac{2}{3}$  in the head, equal to the snout. Dorsal with 8 rays. Anal 7. Scales 5-37-3. Teeth 2, 4-4, 1. Length 3 inches. Not common so far as known. It is reported from the Red River of the North at Moorhead and Grand Forks (N. D.), and the Red Lake River at Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).

**Notropis atherinoides** Rafinesque.

Sides bright silvery, upper scales with a few dark punctulations; no dark blotches on the sides; a dark dorsal line present; snouts of the spring males rosy; general color translucent, greenish above. Body slender and compressed, the back not elevated. Head short, mouth very oblique, upper lip on a level with the upper part of the pupil. Eye large, longer than the snout. Fins not very large, the dorsal inserted behind the ventrals. Head  $4\frac{3}{4}$ . Depth  $5\frac{1}{2}$ . Eye  $3\frac{1}{4}$ . Dorsal with 8 rays. Anal 11. Scales 5-38-3, with 15 before the dorsal fin. Teeth 2, 4-4, 2. Length 4 to 6 inches. At present this fish is known from but a few places in the state. It was described as *Alburnus rubellus*, Agassiz, Lake Superior, and is noted as quite common in the Red Lake River at Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).

**Notropis dilectus** (Girard).

Body very much elongate and somewhat compressed; pale in color, sides very silvery; a row of black dots above the base of the anal fin; snout and bases of the fins sometimes red; young often speckled. Head contained  $4\frac{2}{3}$  times in the body. Depth  $4\frac{3}{4}$ . Eye larger than the snout, 3 in head. Dorsal with 8 rays. Anal 11. Scales 7-38-3. Teeth 2, 4-4, 2. Length 3 to 4 inches.

A very pretty fish, but not common, so far as known, in Minnesota. Specimens have been taken from the Minnesota and Blue Earth Rivers at Mankato, where it is quite common (Cox, 1891-5); it is reported as very common in the Pomme de Terre River at Appleton; also in the Red River of the North and tributaries (Woolman, 1892, Report U. S. Fish Comm., 1893).

**Notropis rubrifrons** (Cope).

Olivaceous above; the sides silvery; scales with dark edges; a dark dorsal stripe; a dark dotted line at the base of the anal fin; head of the spring males tuberculate; the top and sides of the head and base of the dorsal fin red. Body long, the back not elevated. Head pointed, the mouth rather large and very oblique. Head contained 4 times in the length. Depth  $4\frac{3}{4}$ . Eye 4. Dorsal fin with 8 rays. Anal 10. Scales 5-39-3, with 15 to 17 before the dorsal. Length  $2\frac{3}{4}$  inches. A fish much like *N. atherinoides* and *N. dilectus*. Rather common. Specimens have been taken in the various streams and lakes in the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); and in the Des Moines River at Windom (Cox, 1894).

**Notropis umbratilis** (Girard).

Color dark blue above, light below; a black spot at the base of the front of the dorsal fin; the other fins not marked. Head of the males tuberculate, which tubercles are of a light color. Body compressed; head long and pointed, mouth large, oblique; lower jaw projecting a little. Head contained  $4\frac{1}{2}$  times in the length. Depth 4 to  $4\frac{1}{2}$ . Eye about as wide as the length of the snout, contained 3 to 4 times in the head. Dorsal fins inserted about midway between the ventral and anal fins, contains 7 rays. Anal with 11 rays. Scales 9-40 to 52-3. Teeth 2, 4-4, 2. Length  $3\frac{1}{2}$  inches. This is a variable minnow, and at present seems rare in Minnesota. It is reported from the Cedar River at Austin as rare under *Notropis ardens* (Cope) (Meek, Bull. U. S. Fish Comm., X, 1890, p. 234). Minnesota specimens, no doubt, belong to one of the several varieties described in Jordan & Evermann's Fishes of North and Middle America, to which reference should be had in identification.

Genus **RHINICHTHYS** (Agassiz).**KEY TO THE SPECIES OF RHINICHTHYS.**

- A. Snout projecting considerably beyond the mouth, about twice the length of the eye; a barbel present on the maxillaries. **cataractæ**, 38  
 AA. Snout not projecting much beyond the mouth; about  $1\frac{1}{2}$  times the eye; barbel very small or absent. . . . **atronasus**, 39

**Rhinichthys cataractæ** (Cuvier & Valenciennes). Long-nosed Dace.

Snout long and projecting considerably beyond the mouth; a barbel on each maxillary. Color somewhat olivaceous above, lighter below; many dark blotches present; the back dark brown or even black in some specimens. Spring males with parts of the head and

the lower fins red. Body considerably elongate, almost cylindrical; head long and flattened above; mouth entirely on the under side of the head. Pectoral fins very large in the males. Head contained 4 times in the length. Depth 5. Eye in about the middle of the head, contained 2 times in the snout and 5 times in the head. Dorsal fin with 8 rays. Anal 7. Scales 14-65-8. Teeth 2, 4-4, 2. Length 5 inches. Rather common in the state, especially in the northern part. Specimens have been taken from the Upper Mississippi and tributaries (Nat. Hist. Surv., 1892-3-5), where it is quite common. Specimens collected by Woolman & Cox in Dougherty Creek at Brown's Valley and the Pomme de Terre River at Appleton are listed by Mr. Woolman (Report U. S. Fish Comm., 1893) as *R. cataractæ dulcis* (Girard). I have carefully examined some of the above specimens and compared them with the typical *R. c. dulcis* from the Black Hills and believe that the Minnesota form is simply *R. cataractæ* and not the variety. Representatives of the genus *Rhinichthys* in the state, however, need some careful study.

***Rhinichthys atronasus* (Mitchill).** Black-nosed Dace.

Dark above, sometimes rather spotted; sides with a dark band which passes through the eye and along the snout; below the dark band there is a light lateral band; under parts light, silvery; a red lateral band instead of the light in spring males, their lower fins also red, the red fading to orange late in the summer. Body rather cylindrical, elongate; snout medium, not projecting much beyond the mouth; barbel small. Fins rather small. Head contained 4 times in the length. Depth  $4\frac{1}{2}$ . Eye small, contained  $1\frac{1}{2}$  times in the snout,  $4\frac{1}{2}$  times in the head. Dorsal fin inserted midway between the nostrils and the base of the caudal, contains 7 rays. Anal 7. Lateral line with 64 scales. Teeth 2, 4-4, 2.

Quite a common fish in this state. Specimens have been recorded from the lakes and streams of the Upper Mississippi, where it is common (Nat. Hist. Surv., 1892-3-5); Des Moines River, Win-  
dom, not common (Cox, 1894).

***Rhinichthys atronasus lunatus* (Cope).**

Somewhat heavier than *R. cataractæ*: much mottled in color; no dark lateral band; mouth more inferior. Eye smaller, contained 5 times in the head. Depth contained 5 times in the length. Scales 62. This variety is referred to as probably the common form in Wisconsin and Minnesota in Jordan & Evermann's Fishes of North and Middle America. Specimens from Sand Hill River, Minnesota, are described as *R. arenatus* Garman, Science Observer, 1881, p. 62.



Genus **HYBOPSIS** Agassiz.**KEY TO THE SPECIES OF HYBOPSIS.**

- A. Mouth inferior but horizontal; generally species of small size.
- B. Barbel very long for the size of the fish; front of the dorsal fin behind the front of the ventrals; small species,  $2\frac{1}{2}$  inches; body generally marked with black dots. **hyostomus**, 40
- BB. Barbel conspicuous but not as large as B. compared to the size of the fish; eye very large; front of the dorsal fin before front of ventrals; body not marked with black dots. **storerianus**, 40
- AA. Mouth terminal; front of dorsal fin a little behind the front of the ventrals; snout long and blunt; may reach a length of 10 inches. . . . . **kentuckiensis**, 41

**Hybopsis hyostomus** (Gilbert).

Color pale silvery, dotted with many small black spots. Body slender and cylindrical; snout long and pointed, projecting considerably beyond the mouth; mouth on the lower side of the head and rather wide; maxillary barbels present and long; pectoral fins large. Head 4 in length. Depth  $5\frac{1}{2}$ . Eye  $3\frac{1}{4}$ . Dorsal fins with 8 rays. Anal 8. Lateral line with 37 scales. Length  $2\frac{1}{2}$  inches. Not very common in the state. Twenty or more specimens have been taken from the Blue Earth River at Mankato (Cox, 1891-2).

**Hybopsis storerianus** (Kirtland).

Sides, under parts, cheeks and opercles bright silvery; upper parts greenish; an indistinct lateral band sometimes present; no black spot at the base of the caudal fin and the fins never with red. Body rather elongate, compressed, back a little elevated; head short and broad between the eyes; mouth rather small, the lower jaw not projecting; barbels prominent; snout much decurved, its tip somewhat thickened. Head contained  $4\frac{1}{3}$  times in the body. Depth 4. Eye very large, inserted in the upper part of the head, about midway between the tip of the snout and the posterior edge of the opercle, about as wide as the length of the snout, contained 3 times in the head. Dorsal fin with its first rays inserted over the first rays of the ventrals, contains 8 rays. Anal 8. Scales 542-4, the lateral line decurved. Teeth 1, 4-4, 0. Length 5 to 10 inches. Caudal fin deeply forked. Not very common in the state, according to present information. Specimens have been taken in the Red River of the North at Moorhead and Grand Forks (N. D.); Otter Tail River at Breckenridge and Red Lake River at Crookston and Grand Forks (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 371).

**Hybopsis kentuckiensis** (Rafinesque) River Chub.

Color somewhat bluish; a dark bar behind the opercles; scales on the upper part of the body dark edged; under parts bright rosy in spring males; fins slightly yellowish and without black; a red spot on each side of the head in spring males. Body rather stout; not much compressed; mouth large, not oblique, the lower jaw included; barbel conspicuous; adult specimens with a swollen crest on top of the head, this crest covered with tubercles. Head contained 4 times in the length. Depth  $4\frac{1}{2}$ . Dorsal fin with its first rays inserted a little behind the first rays of the ventrals, contains 8 rays. Anal 7. Scales 6-41-4, 18 rows before the dorsal fin; lateral line somewhat decurved. Pharyngeal teeth 1, 4-4, 1 or 1, 4-4, 0, sometimes 4-4. Length 6 to 9 inches.

Quite common in the state. Specimens have been recorded from Basset's Creek, Minneapolis (T. S. Roberts, 1879); Crow Wing River and Fish Hook Lake, Hubbard County; the region of Lake Pelican, Crow Wing County (Nat. Hist. Surv., 1893); Dougherty Creek and Little Minnesota River, Brown's Valley; Upper Minnesota River and Red Lake River, Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893); Minnesota and Blue Earth Rivers at Mankato, common (Cox, 1891-5).

**Order APODES.****Family ANGUILLIDÆ.** The Eels.

Body long and snake-like and covered with small elongated scales which are imbedded in the skin and some of them arranged at right angles with each other. Head small and conical, the bones much modified from those of the typical fish; preopercle and premaxillary bones at present; the maxillaries absent. No ventral fins present; dorsal fin long and its rays short; pectoral fins present. But one genus and one species found in Minnesota.

**Genus ANGUILLA** Shaw.**Anguilla chrysypa** Rafinesque.

Tail somewhat compressed; a well developed lateral line; head rather long; eye small and located well forward. The jaws and vomer well set with teeth which are somewhat unequal in length; outer end of the tongue free; lower jaw projecting beyond the upper; gill openings slit-like. Dorsal fin continuous with the

caudal and anal. Upper parts of the body dark brown in color; lower parts light. Head contained  $8\frac{1}{2}$  times in the length. Length 4 feet.

Very few data have been collected concerning the eel in Minnesota, but it is, no doubt, quite common. There is a skin in the University Museum which is thought to have been taken from the Mississippi at Minneapolis, although there are no definite data concerning it. There is a specimen in the museum of the Mankato State Normal School which was taken from the Minnesota River at Mankato in the spring of 1894 by some fishermen.

### Order **ISOSPONDYLI**.

#### Family **HIODONTIDÆ**. The Moon-eyes.

Body very much compressed; rather long. Head short, covered with scales and having a blunt snout; mouth medium sized, obliquely set and with equal jaws; maxillary bones small. Teeth well developed in the jaws, tongue, vomer, palatines and pterygoids. Eye very large; nostrils large; gill membranes free from the isthmus; 8 to 10 branchiostegal rays. Scales large; a straight lateral line present. Gill rakers short and thick and not numerous. Stomach horseshoe-shaped; one pyloric cæcum; a large air-bladder.

But one genus and one species known in Minnesota.

#### Genus **HIODON** Le Sueur.

**Hiodon tergisus** Le Sueur. Moon Eye. Toothed Herring.

Color light silvery, a little darker above. Body considerably compressed, rather long; pectoral fins not extending to the ventrals; belly compressed into a ridge behind the ventrals. Head  $4\frac{1}{3}$ . Depth 3. Eye very large, contained 3 times in the head. Scales 5-55-7. Dorsal fin with 12 rays. Anal 28. Length 12 inches. Rather a common fish in the northern part of the state. Specimens have been taken from the Mississippi River at Minneapolis (W. H. Chambers, 1880); Red River of the North at Moorhead and Grand Forks (N. D.); Red Lake River at Crookston, at all of which places it is common (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 371).

#### Family **DOROSOMIDÆ**. The Gizzard Shad.

Body much compressed; very broad from the dorsal to the ventral fins (deep); scales thin, dropping off easily; belly compressed



to a saw edged ridge. Head small and scaleless; mouth small and inferior; snout projecting beyond and overhanging the mouth; maxillary bones not prominent; premaxillaries not protractile. Gill rakers numerous and slender; gill membranes free from the isthmus; branchiostegal rays about 6; pseudobranchia well developed. Stomach gizzard-like; a fatty eyelid. One genus and one species represented in the state.

Genus **DOROSOMA** Rafinesque.

**Dorosoma cepedianum** (Le Sueur) Hickory Shad.

Color silvery, the upper parts bluish; a dark spot on the shoulders in small specimens. Body compressed; back elevated. Head contained  $4\frac{1}{3}$  times in the length. Depth  $2\frac{1}{2}$ . Eye  $4\frac{1}{2}$  in the head. Dorsal fin with 12 rays, its first ray developed in a long filament. Anal 31. Scales 56-23; no lateral lines present. Caudal fin considerably forked, the lower lobe the longer. Length 15 inches.

Common in the southern part of the state, no doubt. Specimens have been recorded from the Minnesota River at Mankato, where it is quite common. Many large ones were taken in the river here just as the ice broke up in the spring of 1892. Fishermen stated that it was the first time these fish had been seen in several years. Since that time many small and occasionally large specimens have been taken.

Family **SALMONIDÆ**. The Salmon.

Body rather long; head scaleless; mouth varying much in size; scales cycloid; maxillaries pretty well developed, forming a part of the upper jaw; upper jaw not protractile; teeth variable. A slit behind the fourth gill; pseudobranchia developed; gill membranes not joined to the isthmus; branchiostegal rays 10 to 20; no barbels present. An adipose fin always present; caudal fin forked; pectoral fins inserted near the lower edge of the body. Air-bladder large. Many pyloric cæca present.

This is one of the important families of fishes in our state and, at present, it is known to be represented by four genera and seven species, all of which are valuable food fishes.

## KEY TO THE GENERA OF SALMONIDÆ.

- A. Mouth small; maxillary bones broad; teeth none, or very few; supplemental maxillary bone present.
  - B. Lower jaw short and generally not longer than the upper; mouth not widely cleft; premaxillary bones broad, their cutting edges nearly vertical. . . . . **Coregonus**, 44
  - BB. Lower jaw long, projecting beyond the upper; mouth widely cleft; premaxillaries with their cutting edges nearly horizontal. . . . . **Argyrosomus**, 45
- AA. Mouth large; maxillary bones narrow; teeth present, strong and complete; anal fin with 9 to 12 rays; scales very small.
  - B. No bright colors, spotted with gray; vomer with a toothed crest or ridge. . . . . **Cristivomer**, 47
  - BB. Body dotted with red spots, these fading to white in alcohol; lower fins edged with red; no crest or ridge on the vomer. . . . . **Salvelinus**, 47

Genus **COREGONUS** (Artedi) Linnæus.**Coregonus clupeiformis** (Mitchill). Common Whitefish.

Color white but not silvery, darker above. Body much compressed, long; back somewhat elevated. Head small; snout short and blunt; maxillary bone contained about 4 times in the head, its tip reaching back of the front of the eye socket. Gill rakers  $\frac{1}{2}$  as long as the width of the eye, 10+17 to 19. Head contained 5 times in the length. Depth 3 to 4. Eye 4 to 5 in the head. Dorsal fin with 11 rays. Anal 11. Scales 8-74-9. Length 2 feet.

This is our common white-fish of Lake Superior and possibly it may be found in some of the smaller lakes. Many people report a white-fish from the smaller lakes, but no specimens have been taken in the various collections. It remains to be determined whether the fishes reported are this or *Argyrosomus nigripennis*. It was described as *C. sapindissimus* Agassiz, Lake Superior, 344, 1850, from Lake Superior, also as *C. latior* Agassiz from the same place in the same work, page 348. It is taken in abundance at all the fishing stations on Lake Superior during the fishing seasons.

Genus **ARGYROSOMUS** Agassiz.**KEY TO THE SPECIES OF ARGYROSOMUS.**

- A. Body long; scales small, of about the same size, their free edges not straight but convex, marked with dark dots.
- B. Lower fins pale or merely tipped with dusky; scales dotted with black.
  - C. Eye large; about equal to the snout, contained  $3\frac{1}{2}$  to  $4\frac{1}{2}$  times in the head; head long,  $4\frac{1}{2}$  in the length; pectoral fins short, reaching about half way to the ventrals; gill-rakers long and numerous, 16+30. . . . . **artedi**, 45
  - CC. Eye small, its width less than the length of the snout, contained 5 times in the length of the head; head long, 4 to  $4\frac{1}{2}$  in the length; maxillary very long,  $2\frac{1}{2}$  in the head; lower jaw considerably projecting; gill-rakers about 15+28. . . . . **prognathus**, 45
  - BB. Lower fins all blue-black; body strong; mouth large; eye large; gill-rakers 18+30. . . . . **nigripennis**, 46
- AA. Body short, compressed, curved about as much on the back as on the belly; scales large, their free margins almost straight; jaws about equal; mouth rather small. . . . . **tullibee**, 46

**Argyrosomus artedi** (Le Sueur). Cisco. Lake Herring. Michigan Herring.

Sides silvery, scales dotted with black; bluish or greenish above; fins pale, except the lower, which may be dusky tinged. Body elongate, compressed, back not elevated; head rather long, compressed and pointed; mouth rather large; maxillary bone reaching nearly to the pupil, contained  $3\frac{1}{4}$  to  $3\frac{1}{2}$  times in the head. Gill rakers long and slender, 15 to 17+28 to 34, the longest contained 1 2-5 times in the eye. Head contained  $4\frac{1}{2}$  times in the length. Depth  $4\frac{1}{2}$ . Eye 4 to  $4\frac{1}{2}$ . Dorsal fin with 10 rays, its first rays high, the last much shorter. Anal 12. Scales 8-75 to 90-7. Length 12 inches.

Very common in Lake Superior and possibly in some of the small lakes, but its presence in the latter is still doubtful.

**Argyrosomus prognathus** (H. M. Smith). Long Jaws. Bloater.

Sides bright silvery with bluish reflections; upper parts dusky; lower parts white; scales above the lateral line with their lower edges dotted with black, center of the scales bright, thus forming light longitudinal stripes which extend the whole length of the body. Fins rather pinkish, the dorsal and caudal with dusky edges. Body oblong, compressed, back elevated; mouth large; snout straight; maxillary contained  $2\frac{1}{2}$  times in the head, its length  $3\frac{1}{2}$  times its greatest width; lower jaw projecting beyond

the upper. Head short, contained  $4\frac{1}{3}$  times in the length. Dorsal fin with 9 or 10 rays, the longest  $\frac{1}{3}$  longer than the base of the fin; the first ray inserted nearer the snout than the base of the caudal fin. Anal with 10 to 12 rays, the longest ray equal to the length of the fin. Eye small, contained  $1\frac{1}{3}$  times in the snout. Scales 9-75-8. Gill rakers 15+28, about as long as the width of the eye.

This is probably a common fish in Lake Superior, although there is no recent data concerning it. It is described from Outer Island, Lake Superior, as *Argyrosomus hoyi* Milner, Report U. S. Fish Comm., XI, 1872-3 (1874), p. 86. (See Jordan & Evermann's Fishes of North and Middle America, I, 472).

**Argyrosomus nigripennis** Gill. Bluefin. Blackfin.

Sides silvery, upper parts dark bluish; dark dots on the sides; fins all blue-black. Body rather heavy, compressed; back not elevated; head large; mouth large, lower jaw projecting somewhat; maxillary bone reaching the front of the pupil, 1.5 longer than the width of the eye. Head contained 4 times in the length. Depth 4. Eye large, longer than the snout, contained 4 1.5 times in the head. Dorsal fin with 12 rays. Anal 12. Scales 9 or 10-73 to 77-7 or 8. Length 18 inches.

This is likely the white-fish that is reported so often from the small lakes in the northern part of the state, although there is no definite data concerning it except as listed from Lake Miltona, Minnesota, in Jordan & Evermann's Fishes of North America, I, 472. White-fish, which may be this species, are reported very common in Leech Lake (Nat. Hist. Surv., 1895), where they are taken in gill nets by the Indians.

**Argyrosomus tullibee** (Richardson). Tullibee. Mongrel Whitefish.

Sides white, edges of the scales with black dots; their centers silvery, the silver areas forming longitudinal stripes; upper parts of the body bluish. Body short, much compressed, curved as much on the dorsal as on the ventral side. Head pointed; mouth large, maxillary bone as long as the width of the eye, extending back of the front of the eye. Head contained 4 to  $4\frac{1}{2}$  times in the length. Depth 3 to 3 1.5. Eye large, contained  $4\frac{1}{2}$  times in the head, as wide as the length of the snout. Dorsal fin with 11 or 12 rays. Anal 11. Scales with their free margins rather straight, much larger anteriorly than posteriorly, 8 or 9-67 to 74-8. Gill rakers slender, 16+31, the longest equal to the eye. Length 18 inches.

A very common fish in the state. Numerous specimens have been taken from the lakes of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); Lake of the Woods (Woolman & Cox, 1894).



Genus **CRISTIVOMER** Gill & Jordan.

**Cristivomer namaycush** (Wallbaum). Great Lake Trout. Mackinaw Trout.

The color varies from almost white to gray and very nearly black; round light spots everywhere on the body; wavy lines on the head; a network of light and dark colors on the dorsal and caudal fins. Body elongate; head very long, flattened above; mouth very large, maxillary bone extending beyond the eye, nearly half as long as the head; teeth strong. Head contained  $4\frac{1}{2}$  times in the length. Depth 4. Eye large, contained  $4\frac{1}{2}$  times in the head. Dorsal fin with 11 rays. Anal 11. Caudal fin deeply forked; adipose fin small. Lateral line with 185 to 205 scales. Branchiostegal rays 11 or 12. The average length is 17 to 36 inches, although specimens have been taken that are much longer. Immense numbers are taken annually in Lake Superior, and it is quite common in some of the smaller lakes. A specimen taken in Pokegama Lake near Grand Rapids by H. D. Powers in August, 1895, weighed a little more than 25 pounds and measured 42 inches, total length. A half-tone cut showing this specimen is given on the first page of the cover of Recreation for January, 1896, and in the same number will be found a note, page 61, concerning its capture.

**Cristivomer namaycush siscowet** (Agassiz). Siscowet.

The skin very much thicker than in *C. namaycush*; scales smaller, 175 in the lateral line; teeth weaker; supplemental maximillary bone broader and shorter; head shorter and the flesh of the entire body with much more fat. Mouth very large; caudal fin well forked; maxillary a little more than half the length of the head. Coloration the same as *C. namaycush*.

This fish is known only from Lake Superior, where it is common. It was first described from there as *Salmo siscowet* Agassiz, Lake Superior, 333, 1850. It is taken at most of the fishing stations on the lake, but is not as abundant as *C. namaycush*.

Genus **SALVELINUS** (Nilsson) Richardson.

**Salvelinus fontinalis** (Mitchill). Brook Trout. Speckled Trout.

Back mottled with olive or black; sides with many red spots when alive, these fading to white in alcoholic specimens; dorsal and caudal fins mottled with dark bands or spots; lower fins dark shaded; belly in the males sometimes red. Body oblong, only moderately compressed, back not much elevated. Head large, snout blunt; mouth large; maxillary reaching beyond the eye; eye large.

Head contained  $4\frac{1}{2}$  times in the body. Depth  $4\frac{1}{2}$ . Dorsal fin with 10 rays. Anal 9. Scales 37-230-30. Gill rakers about 6+11. Length 18 inches.

This valuable fish is found native in the state only in the streams which flow into Lake Superior from the north, where it is quite common.

## Order **HAPLOMI.**

### Family **UMBRIDÆ.** The Mud Minnows.

Soft rayed fishes. Body rather heavy, compressed posteriorly; head large and flattened above; mouth of medium size with teeth on the jaws, vomer and palatine bones; upper jaw not protractile; maxillary bones forming the posterior part of the upper jaw. Gill rakers not well developed; branchiostegal rays 6 to 8. The cycloid scales cover the head and body, no lateral line. No pyloric cæca; pseudobranchia not well developed; air-bladder simple.

But one genus and one species found in the state.

### Genus **UMBRA** (Krämer) Müller.

#### ***Umbra limi*** (Kirtland). Mud Minnow. Dogfish.

Color dark, sometimes almost brown, much mottled; 14 narrow light cross bars; a dark bar at the base of the caudal fin. Body oblong, rather heavy. Head contained  $3\frac{3}{4}$  times in the length. Depth  $4\frac{1}{4}$ . Dorsal inserted rather posteriorly, but its first ray further forward than the first ray of the anal, contains 14 rays. Anal 8. Ventrals with 6 rays. Branchiostegal rays 6. Length 4 inches.

Not a very common fish in the state. A fish fond of muddy streams and pools where there is aquatic vegetation, although itself carnivorous. Specimens have been recorded from the region of Gull and Cass Lakes in Cass County; Leech Lake (Nat. Hist. Surv., 1893-5); Lakes Wita and Washington, near Mankato (Cox, 1893-4).

### Family **LUCIIDÆ** The Pikes.

Body very much elongate, the back not elevated, not greatly compressed. Head very long and much depressed; cleft of the mouth about half the length of the head; lower jaw longer than the upper; upper jaw not protractile; maxillary bones forming a part

of the upper jaw; jaws, vomer and palatine bones well set with teeth; some small teeth on the tongue. Gill openings large; gill membranes free from the isthmus; gill rakers tubercle-like and toothed; branchiostegal rays 12 to 20. Scales small; lateral line not well developed, especially in young specimens. Dorsal fin inserted far back, about opposite the anal. No barbels, adipose fin of pyloric cæca; air-bladder simple.

One genus and two species represented in the state.

### Genus **LUCIUS** Rafinesque.

#### KEY TO THE SPECIES OF LUCIUS.

- A. Cheeks entirely covered with scales; branchiostegal rays 11 to 16. . . . . **lucius.**  
 AA. Lower half of the cheeks and opercles without scales; branchiostegal rays 17 to 19. . . . . **masquinongy.**

**Lucius lucius** (Linnæus). Common Pike, Pickerel.

Color grayish with many circular or oval white spots, these spots sometimes of a yellowish hue; black spots on the dorsal, caudal and anal fins. Body considerably elongate, back not elevated; head long; eye inserted midway between the snout and the posterior margin of the opercle. Cheeks covered with scales; lower half of the opercles scaleless; 123 scales in the lateral line. Head contained  $3\frac{1}{3}$  times in the length. Depth 5. Eye  $6\frac{1}{3}$  in the head,  $3\frac{1}{3}$  in the snout. Snout contained 2 2-5 times in the head. Dorsal inserted far back, over the anal, contains 16 to 17 developed rays. Anal 13 to 14. Branchiostegal rays 14 to 16. Length 4 feet.

This is one of the most common fishes in the state. There is scarcely a lake or stream from which it has not been taken. Detailed data concerning its distribution is unnecessary.

**Lucius masquinongy** (Mitchill). Muskallunge. Maskinongy. Muscallonge. Great Pike.

Color considerably lighter than that of the *L. lucius*; irregular black spots on the sides; lower parts white; fins spotted with black. Cheeks without scales on their lower halves. Head contained  $3\frac{2}{3}$  times in the length. Depth 6. Snout contained  $2\frac{2}{3}$  times in the head. Dorsal fin with 17 rays. Anal 15. Branchiostegal rays 17 to 19. One hundred and fifty rows of scales between the opercle and base of the caudal. Length 4 to 8 feet.

This species does not differ greatly from *L. lucius* except in the scaleless cheeks, number of branchiostegal rays and the color, yet



it grows much larger and sometimes reaches a weight of 100 pounds. It is quite common in the lakes of the Upper Mississippi System, where numerous specimens have been taken by the Nat. Hist. Surv. The heads of two which were taken in Leech Lake in the summer of 1895 are now in the University museum. One of these fish weighed 36 pounds, and the other 30.

Another one was reported as having been taken which weighed 65 pounds. The muskallunge is not generally so common as the pickerel, and for some unknown reason small specimens of the former are rarely taken. Amateur fishermen do not generally distinguish between the two fish, but call all large specimens of either muskallunge.

#### Family **PÆCILIIDÆ**. The Killifishes.

Body somewhat elongate, compressed posteriorly; head considerably depressed; scales cycloid and rather large; lateral line wanting or very imperfect. Mouth very small; lower jaw projecting, upper jaw very protractile; teeth present in the jaws and sometimes on the vomer. Gill membranes free from the isthmus; gill rakers short and heavy. Branchiostegal rays 4 to 6; pseudo-branchia not developed. Dorsal fin single, composed of soft rays only, inserted far back; caudal not forked; ventral fins inserted on the abdomen; no adipose fin; no pyloric cæca; air-bladder sometimes absent.

There is known at present but one genus and one species in the state.

#### Genus **FUNDULUS** Lacépède.

##### **Fundulus diaphanus** (Le Sueur).

Color olivaceous, sides much barred with olive and silvery cross bands; back sometimes spotted; fins not much marked. Body medium; posterior portion compressed; head depressed. Head contained 4 times in the length. Depth 4 4-5. Eye  $3\frac{1}{2}$  in the head. Dorsal fin with 13 rays, inserted far back, its first rays before the first rays of the anal or over them, not very large. Anal 11. Scales cycloid, 45-15. Jaws with pointed teeth. Length 4 inches.

This little fish is fond of muddy brooks and ponds where there is aquatic vegetation; quite common in the state. Numerous specimens have been recorded from the various streams and lakes in the vicinity of Mankato and southwest (Cox, 1891-5); the streams and lakes of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); the streams and lakes of the Upper Minnesota River (Woolman & Cox, 1892).

Order **HEMIBRANCHII.**Family **GASTEROSTEIDÆ.** The Sticklebacks.

Body somewhat compressed; the portion before the caudal fin (caudal peduncle), very small. Head of medium size; mouth moderate, the lower jaw projecting beyond the upper; maxillary bent, overlapping the premaxillary at the corner of the mouth; jaws set with sharp, even teeth; upper jaw protractile. Body not covered with true scales; dorsal fin preceded by several free spines; branchiostegal rays 3; ventral fins each with a stout spine; pectoral fins inserted far back. Air-bladder simple; a small number of pyloric cæca present.

Small carnivorous fishes, represented in our state by two genera and at least two species.

**KEY TO THE GENERA OF GASTEROSTEIDÆ.**

- |     |                                 |           |                       |
|-----|---------------------------------|-----------|-----------------------|
| A.  | Dorsal fin with 4 to 5 spines.  | . . . . . | <b>Eucalia</b> , 51   |
| AA. | Dorsal fin with 9 to 11 spines. | . . . . . | <b>Pygosteus</b> , 52 |

Genus **EUCALIA** Jordan.

**Eucalia inconstans** (Kirtland). Brook Stickleback.

Color varying to black, under parts usually lighter; some red on the anterior parts of the spring males. Body somewhat elongate, moderately compressed; the portion before the caudal fin very small; no scales. Gill membranes somewhat free posteriorly; gill rakers short; a ridge or keel along the base of the tail. Head contained in the length  $3\frac{1}{2}$  times. Depth 4. Dorsal fin with 4 or 5 free spines and 10 soft rays (IV-I, 10). Anal I, 10. Length  $2\frac{1}{2}$  inches.

A very common little fish. Specimens have been taken in the streams of the Upper Mississippi (Nat. Hist. Surv., 1893); streams in the vicinity of Mankato and the southwest (Cox, 1891-95); the Upper Minnesota River and the Red River of the North and tributaries (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 372).

**Eucalia inconstans pygmæa** (Agassiz).

This variety is said to differ from the typical *E. inconstans* in having a shorter and deeper body and the dorsal fin with III or IV-I, 6 rays. Anal I, 6. It was described from Lake Superior as *Gasterosteus pygmæus* Agassiz, Lake Superior, 314, 1850. There is some doubt as to the validity of this variety, so the Nat. Hist. Surv. desires very much to get a large series of specimens from the Lake Superior region.

Genus **PYGOSTEUS** Brevoort.

**Pygosteus pungitius** (Linnæus). Nine-spined Stickleback.

Olive above, much dotted; sides barred with dark; belly silvery. Body slender, a little compressed, the portion before the caudal fin very small. Head short and blunt; eye wider than the length of the snout. Dorsal spines not all pointing in the same direction; anal spine larger than the dorsal; gill rakers long and slender. Head contained 4 times in the length. Depth 5 to 6. Dorsal rays VIII or IX-1, 9. Anal I, 8. Length 3 inches.

Not common in the state, so far as known. It was described from Lake Superior as *Gasterosteus nebulosus* Agassiz, Lake Superior, 310, pl. 4, fig. 4, 1850. A specimen in the University museum was taken in Lake Superior at Grand Marias by T. S. Roberts in 1879.

Order **ACANTHOPTERI**.

Family **PERCOPSIDÆ**. The Trout Perches.

Body elongate, rather heavy anteriorly, compressed posteriorly. Head rather pointed; mouth small; eye large; maxillary bones small; premaxillaries forming the upper jaw; upper jaw protractile; the jaws set with weak teeth. Gill membranes free from the isthmus; pseudobranchia developed; branchiostegal rays 6; gill rakers tubercle-like. The bones of the head cavernous; scales ctenoid, lateral line present. Several well developed pyloric cæca.

Genus **PERCOPSIS** Agassiz.

**Percopsis guttatus** (Agassiz). Trout Perch.

Body somewhat mottled with light and dark colors, upper parts with many dark spots. Body rather heavy, quite small just before the caudal fin; head conical, not covered with scales; mouth small. Head contained 3 4-5 times in the length. Depth  $4\frac{1}{3}$ . Dorsal fin inserted about the middle of the body, its rays II, 9. Anal I, 7. Ventrals each I, 8. About 50 scales in the lateral line. Length 6 inches.

This little fish is everywhere common in the northern part of the state. A large number of specimens have been collected in the streams and lakes of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); more than 500 specimens were taken at one haul with a small seine in the St. Louis River at the mouth of the Cloquet River (Woolman & Cox, 1894).



Family **APHREDODERIDÆ**. The Pirate Perches.

Body considerably compressed; back somewhat elevated; head flattened above. Mouth of medium size, rather oblique, lower jaw projecting beyond the upper. Jaws, vomer, palatines and pterygoids with teeth; upper jaw not protractile; maxillary bones well developed; preopercle and preorbital with their edges toothed or serrate; a spine on the opercle. No pseudobranchia; 6 branchiostegal rays; scales ctenoid, no lateral line. Vent in adult specimens located just back of the lower jaw. Air-bladder simple; pyloric cæca 12.

Genus **APHREDODERUS** Le Sueur.**Aphredoderus sayanus** (Gilliams). Pirate Perch.

Color very dark, dotted with darker. Caudal fin with two black bars at its base, a lighter bar between these. Body oblong, rather heavy anteriorly, compressed posteriorly; back somewhat elevated in the region of the dorsal fin. Dorsal fin rather high, its rays II, 6. Ventrals 7. Head contained 3 times in the length. Depth 3. Scales ctenoid, varying from 45 to 60 in a direct line from the opercle to the base of the caudal fin. Length 5 inches.

The interesting point about this little fish is the location of its vent, which in the young is situated in about the natural position, but as the fish matures the vent gradually passes forward, and in the adult it is located just back of the mouth.

At present there is but one specimen recorded in the state, and that is now in the museum of the Mankato State Normal School. It was secured at Winona by Prof. J. M. Holzinger, where it is said to be rare. The fishermen at Winona call it a black bass, but consider it different from our common bass.

Family **ATHERINIDÆ**. The Silversides.

Body elongate, compressed; scales usually cycloid, but not in our species, no lateral line; jaws, vomer and palatines set with teeth. Upper jaw not protractile; gill membranes free from the isthmus; pseudobranchia developed; gill rakers long and slender; branchiostegal rays 5 or 6. Two dorsal fins, these far apart, the first composed of 3 to 8 slender spines, the second of soft rays; anal fin preceded by one spine; ventral rays I, 5. A well developed air-bladder but no pyloric cæca. The family is represented in the state by but one genus and one species.

Genus **LABIDESTHES** Cope.

**Labidesthes sicculus** (Cope). Brook Silverside. Skipjack.

Color pale olive green, translucent; a bright silvery lateral band present; a dark lateral line above the silvery band; back dotted with black. Body elongate, compressed; head flattened above; snout slender, considerably drawn out, longer than the eye; premaxillaries very protractile; edge of the upper jaw concave; scales cycloid. Head contained  $4\frac{1}{2}$  times in the length. Depth 6. Eye  $3\frac{1}{2}$ . Dorsal fins IV-I, 11, the first very small and the spines very weak. Anal I, 23. Seventy-five scales in a line from the opercle to the base of the caudal. Caudal fin forked. Length  $3\frac{1}{2}$  inches.

Rare in the state. The only record of its occurrence is one specimen in the University Museum, which was picked up dead on the shore of Lake Harriet near Minneapolis, April 19, 1894.

Family **CENTRARCHIDÆ**. The Sunfishes.

Body much compressed and generally short; curve of the back about equal to that of the belly. Mouth variable, large in some and small in others; teeth well developed on the jaws and vomer and occasionally on the palatine bones and the tongue; upper jaw protractile; maxillary well developed, sometimes with a supplemental bone. Gill membranes free from the isthmus; pseudo-branchia not well developed; spiny rays strong; branchiostegal rays 6 or 7. Body well covered with scales, these extending on the opercles and cheeks; lateral line generally complete. Dorsal fins 2, but connected, the anterior with 6 to 13 spiny rays, the posterior of soft rays; anal fin with 3 to 9 spines; 5 to 10 pyloric cæca.

Carniverous fishes represented in the state, according to present knowledge, by six genera and eleven species. The species of this order are very difficult to determine.

## KEY TO THE GENERA OF CENTRARCHIDÆ.

- A. Dorsal fin about equal to the anal in length.
  - B. Anal spines 6; dorsal spines 5 to 8; body much compressed. **Pomoxis, 55**
- AA. Dorsal fin much longer than the anal.
  - B. Body short and deep, its depth usually more than  $\frac{2}{3}$  the length; dorsal fin not deeply notched between the spinous and soft rayed portions.
    - C. Tongue and pterygoid bones covered with teeth; scales ctenoid; gill-rakers about 10; anal spines usually 6. **Ambloplites, 56**
  - CC. No teeth on the tongue and pterygoid bones; anal spines usually 3.
    - D. Supplemental maxillary bones well developed. **Apomotis, 57**
  - DD. Supplemental maxillary absent or very rudimentary.
    - E. Lower pharyngeal bones narrow, the teeth sharp, not conical. **Lepomis, 58**
    - EE. Lower pharyngeal bones broad; teeth blunt and paved. **Eupomotis, 60**
- BB. Body rather long, the depth in the adult  $\frac{1}{3}$  the length; dorsal fin deeply notched; mouth large. **Micropterus, 61**

Genus **POMOXIS** Rafinesque.

## KEY TO THE SPECIES OF POMOXIS.

- A. Dorsal spines not more than 6 or less than 5, generally 6; anal fin not marked with black lines. **annularis, 55**
- AA. Dorsal spines not more than 8 or less than 7, generally 7; anal fin marked with a network of dark lines. **sparoides, 56**

**Pomoxis annularis** Rafinesque. Crappie.

Color silvery, mottled with dark shades, the dark colors forming a series of cross bars. Body rather long for fishes of this family, much compressed; head long, the snout projecting, depressed above the eyes; mouth large, maxillary reaching past the pupil. Fins high, the dorsal and caudal marked with dark green; anal fin little marked. Head contained 3 times in the length. Depth  $2\frac{1}{3}$ . Eye large, contained 4 times in the head. Dorsal rays VI, 15. Anal VI, 18. Thirty-six to 48 scales in the lateral line, 4 or 5 rows on the cheeks. Length 12 inches.

There is some doubt as to the occurrence of this species in the state. I have examined a large series of specimens from the Upper Mississippi, which were collected by the Nat. Hist. Surv., and they all proved to be *P. sparoides*. It is reported, however, from Big

Stone Lake (Woolman, 1892, Report U. S. Fish Comm., 1893). The two species of *Pomoxis* are so much alike in general appearance that they are not generally distinguished, yet it is easily done by counting the dorsal spines. The Nat. Hist. Surv. desires very much to get information concerning the occurrence of this species in the state.

**Pomoxis sparoides** (Lacépède). Calico Bass. Strawberry Bass. Grass Bass.

Color silvery, mottled with olive green, forming irregular dark blotches all over the body. Anal fin, as well as the dorsal and caudal, marked with many irregular cross lines. Body oblong; much compressed; back elevated; head not much depressed over the region of the eyes. Mouth smaller than in the preceding species, maxillary reaching to the posterior edge of the pupil, but not beyond. Fins very high, higher than in *P. annularis*. Head contained 3 times in the length. Depth 2. Dorsal fin high, its height contained 4 to 5 times in the length of the body, its rays VII or VIII, 15. Anal VI, 17 or 18. Scales 40 to 45 in the lateral line, 6 rows on the cheek. Length 12 inches. Very common in the state.

Numerous specimens have been taken in the lakes and streams of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); it is very common in Lake Washington, near Mankato, and specimens have been taken from the Blue Earth River at the same place (Cox, 1891-5).

#### Genus **AMBLOPLITES** Rafinesque.

**Ambloplites rupestris** (Rafinesque). Rock Bass.

General color olive green; the young very much mottled, sometimes yellowish tinged; adult with many broken longitudinal stripes; body only moderately compressed for fishes of this family. Head large and heavy; mouth large; maxillary bone large, a well developed supplemental bone on its upper edge; lower jaw projecting beyond the upper; jaws, vomer, palatines, pterygoids and tongue with teeth. Gill rakers less than 10; branchiostegal rays 6; two flat points on the posterior edge of the opercle; preopercle somewhat serrate. Head contained  $2\frac{3}{4}$  times in the length. Depth 2 to  $2\frac{1}{2}$ . Eye  $3\frac{1}{2}$  in the head. Dorsal fin much longer than the anal, its rays XI, 10. Anal VI, 10. Scales large, 5-39-12, 6 to 8 rows on the cheek. Length 12 inches.

A very common and valuable food fish in all the lakes and streams of the state. Numerous specimens have been taken from the streams and lakes of the Upper Mississippi (Nat. Hist. Surv.,



1892-3-5); from the lakes and streams in the vicinity of Mankato and southwest (Cox, 1891-5); Upper Minnesota River and tributaries and Red Lake River near Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).

Genus **APOMOTIS** Rafinesque.

**KEY TO THE SPECIES OF APOMOTIS.**

- A. Body rather long, its depth  $2\frac{1}{3}$  to  $2\frac{1}{2}$  in the length; supplemental bone on the maxillary well developed; a black spot at the base of the posterior portion of the dorsal fin; black spot on the opercle limited to the bony portion; lateral line with 45 to 55 scales. . . . . **cyanellus.**
- AA. Body short, its depth contained 2 times in the length; lateral line with 40 to 46 scales. . . . . **ischyrus.**

**Apomotis cyanellus** (Rafinesque). Blue-spotted Sunfish. Green Sunfish. Red-eye.

Color variable, occasionally greenish with golden reflections; under parts more yellowish; a blue spot on each scale, these forming faint longitudinal stripes; dark cross bars sometimes present; sides sometimes dotted with black; dorsal, caudal and anal often with blue or green markings; a black spot generally present on the base of the posterior edge of the dorsal and anal fins; small blue lines across the cheeks; iris red; opercular spot small, smaller than the eye, the black confined to the bone, edged with yellow. Body somewhat elongate in the typical form, the adults shorter in proportion than the young; moderately compressed. Head rather large, snout long; mouth large; maxillary and supplemental bone well developed; lower jaw projecting beyond the upper. Head contained in the length 3 times. Depth  $2\frac{1}{2}$ . Dorsal spines short, the longest about equal to the snout, and contained 3 to 4 times in the head, rays X, 11. Anal III, 9. Scales 6 or 7-45 to 55-16, 8 rows on the cheek. Gill rakers X+15. Length 7 inches.

Not very common in the state, according to present information. Specimens have been recorded from Lake Wittlesey as *Brittus mincopas* Cope (Proc. Ac. Nat. Sci. Phila., 84, 1865); one specimen from Vadnais Lake, Ramsey County, and one from Pine Lake, Aitkin County (Nat. Hist. Surv., 1892); one specimen from the Des Moines River at Windom (Cox, 1894).

**Apomotis ischyrus** (Jordan & Nelson).

Rather dark in color, mottled with blue and orange; blue bands on the cheeks, broader than in the preceding species; dorsal and

anal fins with a faint black spot at the base of their posterior portions; much blue on the lower jaw and lower parts. Body rather heavy; back elevated; mouth large, the maxillaries well developed and reaching beyond the middle of the eye, supplemental maxillary bone present. Head rather large, flattened above, contained  $2\frac{2}{3}$  times in the length. Depth 2 1-6. Eye  $4\frac{1}{2}$  in the head, smaller than the black spot on the opercle. Dorsal fins with low, strong spines, its rays IX or X, 12. Anal III, 9 or 10. Scales 5-46-14, the cheek with 6 rows. Length 7 inches.

But little known in the state. Specimens have been taken in Bald Eagle and Vadnais Lakes, Ramsey County (Nat. Hist. Surv., 1892).

### Genus **LEPOMIS** Rafinesque.

#### KEY TO THE SPECIES OF LEPOMIS.

- A. Pectoral fins short, shorter than the head, not reaching farther back than the front of the anal fin; gill-rakers very soft and weak; dorsal spines short; opercular flap long. . . . . **megalotis**, 58
- AA. Pectoral fins long and pointed, not generally shorter than the head, reaching to or beyond the front of the anal; gill-rakers long and slender but strong.
  - B. 33 to 39 scales in the lateral line. . . . . **humilis**, 59
  - BB. 43 to 52 scales in the lateral line; the longer dorsal spine  $\frac{1}{2}$  the length of the head; a black blotch at the base of the posterior portions of the dorsal and anal fins. . . . . **pallidus**, 59

**Lepomis megalotis** (Rafinesque). Long-eared Sunfish.

An abundance of bright colors, back a dark blue, lower parts brilliant orange; spotted with orange on the sides; many wavy blue vertical lines; lips blue; cheeks orange, crossed with blue lines; blue lines in front of the eye; soft rays of the dorsal, caudal and anal blue, the connecting membrane orange. Body much compressed, deep, short, the back much elevated; mouth small, oblique; maxillary well developed, extending to the middle of the eye; gill rakers very short and soft, X+8 or 9. Head without the flap contained 3 times in the length. Depth  $1\frac{2}{3}$  to  $2\frac{1}{2}$ . Eye  $3\frac{1}{2}$  to 4 in the head. Dorsal spines short, the longest about equal to the snout, contained 3 times in the head; dorsal rays X, 10 to 12. Anal III, 8 to 10. Scales 5-36 to 45-14. Opercular flap very long and broad in the adult, edged with blue or red. Length 8 inches.

Not common in the state. The only specimens known are listed from the Pomme de Terre River at Appleton and Big Stone Lake at Ortonville (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 352).

**Lepomis humilis** (Girard). Red-spotted Sunfish.

Color somewhat bluish, spotted with green, many circular red spots on the sides; a dim, black spot at the base of the posterior portion of the dorsal fin; lower fins and lower part of the body red. Body somewhat elongate; back not greatly elevated for fishes of this family. The rather long opercular flap with a red edge surrounding the black. Pectoral fins shorter than the head. Gill rakers well developed,  $X+9$  to 11. Head contained  $2\frac{3}{4}$  to 3 times in the length of the body. Depth  $2\frac{1}{4}$  to  $2\frac{1}{2}$ . Eye 3 to  $3\frac{1}{2}$  in the head. Dorsal fin  $X$ , 10 or 11, its spines rather high, longest spine nearly  $\frac{1}{2}$  the length of the head. Anal III, 8 or 9. Scales 5-33 to 39-11. Length 4 inches.

Probably not common. It was described from Lake Wittlesey as *Bryttus occultatus* Cope (Jour. Ac. Nat. Sci., Phila., 83, 1865). There is no other record of its occurrence in the state.

**Lepomis pallidus** (Mitchill). Blue-gill. Blue Bream. Blue Sunfish.

Color greenish varying to dark in the adult, young lighter, silvery, sometimes purplish; young generally marked with very irregular dark cross bars; cheeks without blue stripes; a black spot generally present at the base of the last dorsal and anal rays, distinct in the adult and often wanting in the young; fins never red, but sometimes the lower part of the body is dull red. Body much compressed, short and deep, adults much shorter in proportion than the young. Head medium, depressed above the eyes; mouth small and oblique; lower jaw not projecting; maxillary bone reaching the front of the eye socket; opercular flap rather small in the young, becoming longer and wider in proportion in the adult, edge not pale; gill rakers moderate,  $X$ , 11 to 13. Head contained about 3 times in the length. Depth about 2. Eye  $3\frac{1}{2}$  to 4 in the head. Dorsal spines  $X$ , 11 or 12, strong, the longest  $\frac{1}{2}$  the length of the head. Anal III, 10 to 12. Scales 7-43 to 52-16, 5 rows on the cheek. Length 12 inches.

Very common in the state. Specimens have been recorded from Fort Snelling as *Pomotis luna* Girard (Proc. Ac. Nat. Sci., Phila., 201, 1857); common in the streams and lakes of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); Big Stone Lake and Minnesota River at Ortonville, very common (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 352).

Genus **EUPOMOTIS** Gill & Jordan.**KEY TO THE SPECIES OF EUPOMOTIS.**

- A. No blue lines or orange spots on the cheeks; scales 42 to 44; opercular flap with a broad whitish or orange border; 6 to 7 rows of scales on the cheek. . . . . **euryorus.**
- AA. Wavy blue lines on the cheeks; numerous orange spots on the sides of the body; about 47 scales in the lateral line; opercular flap bordered with red; about 4 rows of scales on the cheek. . . . . **gibbosus.**

**Eupomotis euryorus** (McKay).

The life colors have not been carefully taken. In alcoholic specimens the upper parts are mottled with dark colors; lower parts yellowish; dorsal, caudal, anal and ventral fins dusky, pectorals lighter. Body quite heavy, compressed, very short; back much elevated, making the outline nearly oval; mouth small, oblique, maxillary extending to the front of the eye socket. Outer teeth of the jaws larger than the others, palatine bones with teeth. Pharyngeal teeth, strong, blunt, and not very close to each other. Gill rakers short and stout, about 8 in number. A small supplemental maxillary bone. Opercular flap about as long as the snout, edged with a broad, pale membranous portion. Head contained  $3\frac{3}{4}$  times in the length. Depth 2.2-5. Dorsal fin, X, 11, spines short, about equal to the length of the snout. Anal III, 10. Scales 64-14, 6 to 7 rows on the cheek, 5 rows on the opercle. Length 8 inches.

This heretofore rather rare fish may prove to be common in Minnesota. A few specimens have been taken from Lake Kilpatrick, near Gull Lake (Nat. Hist. Surv., 1893).

**Eupomotis gibbosus** (Linnaeus). Common Sunfish. Bream. Pumpkin Seed. Sunny.

Color greenish above, tinged with blue in places; orange spots on the sides; belly and cheeks often deep orange; cheeks with distinct blue lines, these white in alcoholic specimens; lower posterior edge of the opercular flap red, this mark important in adult specimens. Body short, deep and compressed; back considerably elevated. Head small, depressed above the eyes; mouth small, maxillary barely reaching the eye. Pharyngeal teeth blunt, set very close to each other. Head contained 3 to  $3\frac{1}{4}$  times in the length. Depth  $1\frac{3}{4}$  to 2. Eye 4 to  $4\frac{1}{2}$  in the head. Snout  $4\frac{1}{2}$  in the head. Dorsal fin X, 10 to 12, its spines rather high, the longest 2 to  $2\frac{1}{2}$  in the head. Anal III, 10 or 11. Scales 6-40 to 47, 4 rows on the cheek.



Common in the state. Numerous specimens have been taken in the lakes and streams of the Upper Mississippi (Nat. Hist. Surv., 1893).

Genus **MICROPTERUS** Lacépède.

**KEY TO THE SPECIES OF MICROPTERUS.**

- A. Maxillary bone in the adult not extending beyond the posterior margin of the eye; mouth of medium size; scales about 11-74-17, 17 rows on the cheek. . . . . **dolomieu.**
- AA. Maxillary bone in the adult extending beyond the posterior margin of the eye; mouth large; scales about 7-68-16, 10 rows on the cheek. . . . . **salmoides.**

**Micropterus dolomieu** Lacépède. Small-mouthed Black Bass. River Bass.

Color dark green with golden reflections; sides spotted with dark colors in the young, these spots forming vertical bars in some cases, no dark lateral bands; cheek and opercle with 3 bronze bands; lower parts light; caudal fin tipped with a light colored band, a dark band across the middle of this fin, light colored at the base; dorsal fin not edged with a pale band. Body considerably elongate, moderately compressed; mouth rather large, but not as large as the next, maxillary bone generally reaching the middle of the eye, but rarely extending beyond its posterior edge. Gill rakers  $X+6$  or 7. Head contained  $2\frac{1}{2}$  to  $3\frac{1}{2}$  times in the length. Depth  $3\frac{1}{3}$ . Eye  $1\frac{1}{2}$  to 2 in the snout, 5 to  $6\frac{1}{2}$  in the head. Dorsal fin  $X$ , 13 to 15, deeply notched. Length 1 to 2 feet. A very valuable fish.

Common in the state, especially in the streams. Numerous specimens have been taken from the Minnesota and Blue Earth rivers at Mankato (Cox, 1891-4); Little Minnesota River at Brown's Valley; Big Stone Lake at Ortonville and Chippewa River at Montevideo (Woolman, 1892, Report U. S. Fish Comm., 1893, pp. 352 and 358).

**Micropterus salmoides** (Lacépède). Large-mouthed Black Bass. Oswego Bass. Green Bass. Bayou Bass.

Dark greenish above, lower parts and sides somewhat silvery; young with a dark lateral band; cheeks and opercles with three dark stripes; caudal fin with a pale edge; colors becoming darker with age. Body somewhat elongate, compressed, the adults deeper in proportion than the young. Head large; mouth very large, the maxillary extending beyond the eye in adults, not so long in the

young. Head contained 3 to  $3\frac{1}{2}$  times in the length. Depth 3 to  $3\frac{1}{4}$ . Eye  $1\frac{1}{2}$  to 2 in the snout, 5 to 6 in the head. Dorsal fin X, 12 to 13, deeply notched. Anal II, 10 or 11. Scales 7-65 to 70-18, about 10 rows on the cheek. Length 12 to 18 inches.

This valuable food fish is very common in nearly all parts of the state, especially in the lakes; much more common than the preceding. Specific notes concerning its distribution are unnecessary here, since it has been taken in nearly all the regions where the Nat. Hist. Surv. and others have made collections.

#### Family **PERCIDÆ**. The Perches.

Body elongate; generally covered with ctenoid scales, lateral line usually present, but not always; mouth variable; upper jaw protractile; no distinct supplemental maxillary bone. Teeth present on the jaws and usually also on the vomer and palatines; a spine generally present on the posterior edge of the opercle; branchiostegal rays 6 or 7. Gill membranes free from the isthmus; a slit behind the fourth gill; gill-rakers slender and toothed; pharyngeal teeth sharp. Dorsal fins 2, 6 to 15 spines in the first; anal fin with 1 to 2 spines; ventral fins inserted far forward (thoracic) their rays I, 5. Air-bladder small or even absent; a small number of pyloric cæca.

This interesting family is known at present to be represented in our state by 9 genera and 16 species, 3 species being valuable food fishes, the remainder never reaching more than a few inches in length and not generally distinguished from the minnows by the ordinary fishermen.

## KEY TO THE GENERA OF PERCIDÆ.

- A. Branchiostegal rays 7; preopercle serrate; pseudobranchia (false gills on under side of the opercle) well developed; mouth large.
  - B. Canine teeth (large conical teeth) present on the jaws and palatine bones. . . . . **Stizostedion**, 64
  - BB. No canine teeth present. . . . . **Perca**, 65
- AA. Branchiostegal rays 6; preopercle very little if at all serrate; pseudobranchia very little developed; all small fishes.
  - B. Upper portion of the skull rather depressed, very little convex when seen in cross section.
    - C. Space between the eyes wide, upper jaw not protractile; snout sharp and conical, projecting beyond the mouth. . . . . **Percina**, 65
    - CC. Space between the eyes not wide, snout not projecting much beyond the mouth.
      - D. Body not semitransparent in life; not greatly elongate; well covered with scales.
        - E. Upper jaw not protractile, no groove separating the skin which covers the premaxillaries from the skin of the forehead; anal fin large; scales of the middle line of the belly often dropping off, leaving a naked space. . . . . **Hadropterus**, 66
        - EE. Upper jaw protractile, a groove separating the skin which covers the premaxillaries from the skin of the forehead; anal spine one, this very small; anal fin shorter than the soft dorsal. . . . . **Boleosoma**, 67
      - DD. Body semitransparent in life; very long and slender; belly naked; upper jaw protractile; a row of black dots along the lateral line. . . . . **Ammocrypta**, 68
    - BB. Upper portion of the skull not depressed, convex in cross section; upper jaw not protractile.
      - C. Lateral line developed, at least on the anterior portion of the body; dorsal spines 8 to 14.
        - D. Lateral line straight; body rather heavy. . . . . **Etheostoma**, 69
        - DD. Lateral line slightly curved, running high anteriorly; dorsal fins well separated; body slender. . . . . **Boleichthys**, 71
      - CC. Lateral line not at all developed; dorsal spines 6. . . . . **Microperea**, 72

Genus **STIZOSTEDION** Rafinesque.**KEY TO THE SPECIES OF STIZOSTEDION.**

- A. Rays of the soft dorsal fin about 20, its base  $\frac{1}{6}$  shorter than the spinous dorsal; pyloric cæca 3, each about equal to the length of the stomach; a black blotch on the last dorsal spines; no black blotch on the base of the pectoral fins. . . . . **vitreum.**
- AA. Rays of the soft dorsal fin about 17, its base  $\frac{1}{3}$  less than the spinous dorsal; pyloric cæca 4 to 7, shorter than the stomach and unequal in length; no black blotch on the last dorsal spines; a black blotch at the base of the pectoral fins. . . . . **canadense.**

**Stizostedion vitreum** (Mitchill). Wall-eyed Pike. Pike Perch. Dory. Glass-eye. Yellow Pike. Blue Pike. Jack Salmon. White-eye.

Color dark olive, mottled with brassy; a network of lines on the sides of the head; lower parts and lower fins sometimes pinkish; a large black spot on the last dorsal spines; soft dorsal mottled with dark colors; no black spot at the base of the pectoral fins. Body rather long and slender, heavy; 3 rather long pyloric cæca, as long as the stomach. Head contained  $3\frac{2}{3}$  times in the length. Depth about  $4\frac{1}{2}$ . Eye  $4\frac{1}{2}$  to 5 in the head, not as wide as the length of the snout. Dorsal fin XII to XVI, 19 to 21, its longest spine more than half the length of the head. Anal II, 12 to 14, its length greater than its height. Scales 10-110 to 132-25, very few on the cheeks and upper surface of the head. Length 18 inches to 3 feet.

A very common and valuable food fish. Its definite range has not been determined, but it seems to be very widely distributed. Specimens have been recorded from all the lakes and streams of the Upper Mississippi, where collections have been made (Nat. Hist. Surv., 1893-5); common in the lakes in the vicinity of Mankato, Okabena lakes at Worthington and Round Lake near the same place (Cox, 1894); common in Big Stone Lake (Woolman & Cox, 1892); Otter Tail River at Breckenridge, Red River of the North at Grand Forks (N. D.); Red Lake River at Grand Forks and Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).

Very little attention has been given by collectors in the state to these two species of fishes, but it seems that *S. vitreum* is the one commonly taken.

**Stizostedion canadense griseum** (De Kay). Sauger. Sand Pike.

Color grayish with brassy reflections, the young more distinctly marked than the adult; 2 or 3 rows of circular black spots on the first dorsal fin, no black spot on the last spines; 3 irregular rows of dark spots on the soft dorsal; a large black spot at the base of



the pectoral fins. Body elongate, more cylindrical than *S. vitreum*; head depressed, pointed; opercular spines few and not very prominent. Head contained  $3\frac{1}{2}$  times in the length. Depth  $4\frac{1}{2}$  to 6. Eye 5 in the head. Dorsal fin XI to XV-1, 17 to 19. Anal II, 11 or 12. Scales 9-100 to 125-127. Pyloric caeca 4 to 7, unequal and shorter than the stomach. Length 10 to 18 inches. The variety *griseum* differs from the typical *canadense*, which it is supposed is found only farther east, in having fewer and less developed opercular spines and the head more naked. It seems that this species is much less abundant than *S. vitreum*.

Specimens were described from Lake Pepin as *Lucioptera pepinus* Estes (Hallowell's Sportsman's Gazette, 322, 1877); a few specimens have been taken in the Big Gull Lake and Mayo Creek, a tributary of the same (Nat. Hist. Surv., 1893).

The representative of the genus *Stizostedion* needs some careful study and the Nat. Hist. Surv. will be glad to get any reliable information on the subject.

### Genus PERCA (Artedi) Linnæus.

**Perca flavescens** (Mitchill). Yellow Perch. American Perch. Ringed Perch. Raccoon Perch.

General color yellow; dark, sometimes quite black, on the back; six or eight dark cross bars on the sides; upper fins rather dark; lower fins orange, sometimes tinged with red. Body elongate, compressed; back elevated; mouth rather large; maxillary reaching nearly to the middle of the eye; snout a little longer than the width of the eye. Gill-rakers X=15. Head  $3\frac{1}{4}$  in the length. Depth  $3\frac{1}{4}$ . Dorsal fin XIII to XVII, 13 to 15. Anal II, 7 or 8. Scales 7-74 to 88-17; cheeks covered with scales, opercles nearly naked. A spine on the posterior edge of the opercle, preopercle strongly serrated. Upper jaw protractile; jaws, vomer and palatines set with moderate teeth. Branchiostegal rays 7; pyloric caeca 3. Length 12 to 15 inches.

This well known fish is found in all the waters of the state and generally in abundance. So common is it that specific notes concerning its distribution are here omitted.

### Genus PERCINA Haldeman.

**Percina caprodes** (Rafinesque). Log Perch. Rock-fish. Hog Molly. Hog-fish.

The zebra-like markings on the sides, which are black stripes on a yellowish background, at once distinguish this darter from all the others. Sides with about 15 dark stripes, these alternating

with shorter and fainter ones; caudal fin with a black spot at its base; fins barred with black. Body elongate, not much compressed; head depressed and pointed; mouth small and inferior; snout drawn out, but blunt on the end; premaxillaries not protractile. Head contained 4 to  $4\frac{3}{4}$  times in the length. Depth 5 to  $6\frac{1}{2}$ . Eye  $1\frac{1}{2}$  times the length of the snout, contained 4 times in the head. Dorsal fin XIII to XVII, 12 to 17. Anal 11, 9 to 12. Scales ctenoid, 9-90 to 95-15; present on the cheeks, opercles and back of the neck. Length 6 to 8 inches. A very common darter in the lakes and streams of the northern part of the state.

A large series of specimens have been taken in the Upper Mississippi and its tributaries (Nat. Hist. Surv., 1893-5); Upper Mississippi and tributaries and St. Louis River and tributaries (Woolman & Cox, 1894).

**Percina caprodes zebra** (Agassiz). Manitou Darter.

This variety differs from the typical *caprodes* in having the back of the neck naked, the cross bars more indistinct and about 20 in number. There is a black caudal spot; dorsal and caudal fins mottled with black. Head contained  $4\frac{1}{4}$  times in the length. Depth 7. Dorsal fin XV, 14. Anal II, 10. The lateral line contains about 90 scales.

The only record we have is its occurrence in Lake Superior, from which it was described as *Pileoma zebra* Agassiz (Lake Superior, 308, 1850), and some specimens in the University museum taken from the north shore of Lake Superior (Nat. Hist. Surv., 1878). This variety needs some study.

Genus **HADROPTERUS** Agassiz.

**KEY TO THE SPECIES OF HADROPTERUS.**

- A. Scales small, about 60 to 70 in the lateral line; cheeks with small scales, larger ones on the opercles; several large, black blotches on the sides. . . . . **aspro**, 66
- AA. Scales 50 to 60 in the lateral line; cheeks and opercles with some large scales. . . . . **güntheri**, 67

**Hadropterus aspro** (Cope & Jordan). Black-sided Darter.

Sides with about seven dark spots whose edges join each other; general color yellowish or greenish; upper parts mottled with black. Body elongate, not much compressed except posteriorly, head somewhat elongate; mouth moderate, lower jaw not projecting, maxillary reaching just beyond the front of the eye. Head con-

tained 4 times in the length. Depth 5 to 6. Eye equal to the length of the snout, contained 4 times in the head. Dorsal fin XIII to XV-11 to 13. Anal II, 8 to 10. Scales 9-65 to 80-17, cheeks with very small scales; lateral line also straight; breast naked; back of the neck sometimes naked; middle line of the belly with large scales, which soon drop off, leaving a naked space. Pyloric caeca 3. Length 3 to 4 inches.

Very common in the Minnesota River at Mankato, where a number of specimens have been taken (Cox, 1891-4); a few taken from the Little Minnesota River and Big Stone Lake at Brown's Valley; Minnesota River at Ortonville, rare; Chippewa River at Montevideo, common; Red River of the North at Moorhead, rare; Otter Tail River at Breckenridge, not common (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 372).

**Hadropterus güntheri** (Eigenmann & Eigenmann).

General color yellowish; a series of large dark blotches along the sides similar to those of *H. aspro*; upper parts mottled with black; dark lines before and below the eye; a dark blotch on the anterior and posterior portions of the dorsal fins. Upper jaw not protractile; gill membranes little connected; middle line of the belly with enlarged scales; lateral line complete; well developed teeth on the palatine bones; preopercle not serrate; back of the neck and breast, except the median line naked; 3 series of large scales on the cheeks and opercles; opercle with a stiff spine. Head contained 3 4-5 to 4 times in the length. Depth  $5\frac{2}{3}$  to 6. Dorsal fin X-13 or 14. Anal II, 9 to 11. Scales 5-56 to 57-9.

The only specimens known in Minnesota were taken in the Red River of the North at Moorhead and Red Lake River at Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 373).

Genus **BOLEOSOMA** De Kay.

**Boleosoma nigrum** (Rafinesque). Johnny Darter.

General color yellowish brown; upper parts marked with many irregular darker lines; sides with 7 or 8 W-shaped markings, these very characteristic of this darter; upper part of the head black in spring males, in others dotted with brown; a black line extending from the front of the eye toward the snout, a similar one sometimes extending from the eye downward; fins barred with dark brown; sometimes the whole anterior portion of the body is black in spring males. Body elongate, somewhat cylindrical; head pointed, the snout a little decurved, lower jaw not projecting beyond the upper.

Fins large, the pectoral about the length of the head; spinous dorsal about equal to the soft dorsal in height, the former a little the longer; anal fin small, its spines very small and weak. Head contained  $3\frac{3}{4}$  to  $4\frac{1}{2}$  times in the length. Depth 5 to 6. Eye  $3\frac{3}{4}$  to 4 in the head, about equal to the snout. Dorsal fin IX, 12 to 14. Anal I, 7 to 9. Scales 54 to 55-9, none generally present on the cheeks and breast; opercles, and generally the back of the neck, covered with scales. Opercle with a strong spine. Pyloric cæca 3 to 6. Length 2 to  $2\frac{1}{2}$  inches.

This interesting little fish is everywhere common in the state. Specimens were described from Lake Superior as *Bolcosoma maculatum* Agassiz (Lake Superior, 305, 1850); it is reported very common from the Lake of the Woods (Woolman & Cox, 1894); all the streams and lakes of the Upper Mississippi (Nat. Hist. Surv., 1892-3-5); the Minnesota and Blue Earth rivers and tributaries near Mankato (Cox, 1891-5); Des Moines River and tributaries (Cox, 1894); Upper Minnesota River and tributaries and tributaries of the Red River of the North (Woolman, 1892, Report U. S. Fish Comm., 1893, p. 372).

### Genus **AMMOCRYPTA** Jordan.

#### **Ammocrypta pellucida clara** (Jordan & Meek). Sand Darter.

Semitransparent in life; light yellow after being placed in alcohol; sides with a row of dark dots; a row of dark spots along the back; scales with minute black dots. Body very slender and somewhat cylindrical; head rather large, mouth rather wide; snout sharp, extending beyond the mouth; upper jaw protractile; jaws and vomer with teeth. Head contained 4 to  $4\frac{3}{4}$  times in the length. Depth 7 to  $8\frac{1}{2}$ . Dorsal fin X-10. Anal I, 8 to 10. Scales ctenoid, 6-67 to 78; no scales on the back of the neck and none on the sides anteriorly, except 5 or 6 rows along the lateral line; few scales on the cheeks. Pyloric cæca 4. Length 3 inches. The variety *clara* differs from the typical *pellucida* only in having no scales on the back of the neck and none on the sides anteriorly, except the 5 or 6 rows along the lateral line. It is doubtful whether such a variety should be recognized.

The only place in the state where this interesting little darter has been taken is in the Minnesota and Blue Earth rivers at Mankato, where it is very common (Cox, 1891-5).



Genus **ETHEOSTOMA** Rafinesque.**KEY TO THE SPECIES OF ETHEOSTOMA.**

- A. Lateral line complete.
  - B. Anal spines 2; cheeks and opercles scaly; body slender; dorsal fin X-11; scales 50; no distinct dark spots along the series of scales. . . . . **zonale, 69**
- AA. Lateral line generally incomplete; ventral fins close together; first dorsal and anal very small; anal spines 2; lower jaw not projecting; dorsal fins well separated.
  - B. Shoulder without a distinct scale-like process.
    - C. 4 to 7 rows of scales above the lateral line.
      - D. Cheeks and opercles scaly; scales small, about 60 in the lateral line. . . . . **iowae, 70**
    - DD. Cheeks not entirely scaly, nearly naked; opercles scaly, scales large, about 48 in the lateral line; males with red and blue cross bars. . . . . **cœruleum, 70**
  - BB. Shoulder with a distinct black process or scale.
    - C. Cheeks and opercles naked; lower jaw projecting; dorsal spines low, each projecting in a small fleshy knob in the male. . . . . **flabellare, 71**

**Etheostoma zonale** (Cope).

Upper parts olivaceous, lower parts yellowish; six dark spots on the back, these connected by alternate spots with the broad, brown lateral band; eight narrow bluish bands, alternating with the brown, which extend down on the belly; all of the fins, except the dorsal, golden yellow, spotted with brown; middle of the spinous dorsal crimson; some round crimson spots at the base of the soft dorsal; top of the head, a line on the snout and one below the eye black; a black spot on the opercle and one at the base of the pectoral fins; females with the bright colors more indistinct. Body slender, compressed; head small and short; mouth small and somewhat inferior; snout short and decurved, rather blunt; teeth not well developed; dorsal fins well separated; second dorsal higher and shorter than the first, but larger than the anal. Head contained 4 to 5 times in the length. Depth 5 to 6. Dorsal X or XI-10 to 12. Anal II, 6 to 8. Scales 6-48 to 53-9, present on the cheeks, opercles and back of the neck; breast generally naked. Length 3 inches.

Not common in the state. A few specimens have been taken from the Blue Earth River at Mankato (Cox, 1891-2).

**Etheostoma iowae** Jordan & Meek.

Color in life bright green, much mottled with dark brown; green patches on the opercle; about 11 reddish spots on the sides; a series of dark cross bars present on the sides of some specimens. Spinous dorsal with reddish, greenish and brown longitudinal bands; caudal and pectoral fins often with yellow and green spots; a black line below the eye extending to the lower jaw; general color varying considerably, some specimens being almost black, while others are quite light. Body elongate, not much compressed; snout rather pointed, decurved, its length generally a little less than the width of the eye; mouth small, horizontal, the lower jaw not projecting beyond the upper; maxillary bones reaching beyond the front of the eye. Teeth small; opercular spine well developed. Head contained 3.45 to 4 times in the length. Depth 4 to 5½. Eye 4 to 5 in the head. Dorsal fin IX to X-10 or 11. Anal II, 6 to 8. Scales 55 to 63-11, present on the cheeks, opercles and back of the neck; breast and top of the head naked. Length 2 to 3 inches.

Very common in the state. Numerous specimens have been taken from the Upper Minnesota River and tributaries (Woolman & Cox, 1892); Red Lake River at Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893); Upper Mississippi and tributaries (Nat. Hist. Surv., 1892-5); West Okabena Lake at Worthington and Des Moines River at Windom (Cox, 1894).

**Etheostoma coeruleum** Storer. Blue Darter. Rainbow Darter. Soldier Fish

The males with many dark blotches on the back, these connected by dark lines or spots; sides with 12 bright blue, oblique bars; caudal fin orange, the first and last rays blue; soft dorsal orange, edged with blue, a blue line at its base; spinous dorsal orange, red at the base, blue at the tip; ventral fins deep blue; throat and breast orange. The females were very much duller in color and with very little blue or red. Body rather stout, compressed, back a little elevated; head large, compressed; mouth oblique, lower jaw not reaching beyond the upper, maxillary reaching the eye; a row of palatine teeth present. Head contained 3¾ times in the length. Depth 4¼. Eye 4 to 4½ in the head, not as wide as the length of the snout. Dorsal fin IX to XII-12 to 14. Anal II, 7 or 8. Scales 5-40-10; cheeks, back of the neck and breast usually naked, opercles scaled. Length 2½ inches.

Not common in the state. The only specimens known were taken from the Blue Earth River and ponds near the Minnesota River at Mankato (Cox, 1891).

**Etheostoma flabellare** lineolatum (Agassiz). Fan-tailed Darter.

General color rather dark; body covered with a series of small dark spots which form a series of fine longitudinal lines and which are aggregated in some specimens so as to form several broad cross bars; a dark line usually present across the opercles and through the eyes; soft dorsal and caudal fins barred with fine dark lines, other fins plain. Body rather heavy, not greatly compressed; head pointed; mouth oblique; lower jaw projecting beyond the upper; body deep posteriorly, the anal fin broad and fan-like. The fins all low; the first dorsal in the male  $\frac{1}{3}$  of the height of the second and the spines each with a fleshy tip. Head contained 3.3-5 to 4 times in the length. Depth  $4\frac{1}{2}$  to  $5\frac{1}{2}$ . Eye 4 to  $4\frac{1}{2}$  in the head. Dorsal fin VIII-12 to 14. Anal II, 7 to 9. Scales 9-40 to 65-14; head naked; lateral line straight and not complete; a black scale on the shoulders. Length  $2\frac{1}{2}$  inches.

Not common in the state. But one specimen has been taken and that from the Des Moines River at Windom (Cox, 1894).

Genus **BOLEICHTHYS** Girard.**KEY TO THE SPECIES OF BOLEICHTHYS.**

- |   |                        |
|---|------------------------|
| A. Cheeks and opercles scaly. . . . .     | <b>fusiformis</b> , 71 |
| AA. Cheeks naked, opercles scaly. . . . . | <b>exilis</b> , 72     |

**Boleichthys fusiformis** (Girard).

Color olivaceous, upper parts dotted with darker colors, lower parts lighter; upper part of the head dark, sides with red dots; a dark line extending forward and one downward from the eye; 4 dark spots in a vertical row on the base of the caudal fin; dorsal and caudal dotted and barred with dark colors; spinous dorsal bright blue, a red band across it in the middle. Body elongate, compressed; head long and narrow; snout short and decurved, shorter than the eye; mouth large and terminal, lower jaw not extending beyond the upper; upper jaw not protractile. Head contained  $3\frac{1}{2}$  to 4 times in the length. Depth  $3\frac{3}{4}$  to 6. Eye 4 in the head. Dorsal fin IX or X-9 to 12. Anal II, 6 to 8. Scales 3-43 to 60-12 ctenoid; cheeks scaled; opercles, back of the neck and breast also usually scaled. Lateral line incomplete and located high up on the body. Opercular spine well developed. A variable fish.

This species is but little known to the state. It is listed in the University museum as *Boleicthys eos* from Minneapolis, April 24, 1879, by T. S. Roberts.

***Boleichthys exilis* Girard.**

This species differs from *B. fusiformis* in having naked cheeks. Color yellowish brown, dotted with black; dorsal and caudal fins barred with black; a black spot on the top of the head; a black line extending from the eye to the lower jaw and one forward towards the snout. Body compressed. Head contained  $3\frac{3}{4}$  times in the length. Depth  $5\frac{1}{2}$  to 6. Dorsal fin IX or X-10 or 11. Anal II, 7 to 9. Length 1 to 2 inches.

This species, which must be rare in the state, is listed from the Red River of the North in Jordan & Evermann's Fishes of North and Middle America, I, 1103, the data having been taken from specimens in the Mus. of Comp. Zoöl., N. Y. Other data are needed to establish permanently the presence of both *B. fusiformis* and *B. exilis*.

**Genus MICROPERCA Putnam.*****Microperca punctulata* Putnam. Least Darter.**

General color olivaceous, much shaded with dark brown, which color forms indistinct bars on the sides and many irregular markings; soft dorsal and caudal fins barred; dark lines radiating from the eye; shoulder with a dark spot. Body short, compressed, the back elevated; head not very large, snout decurved; mouth terminal, oblique, jaws equal; maxillary extending to below the eye. Vertical fins short; anal spines well developed. Head contained  $3\frac{3}{4}$  to 4 times in the length. Depth  $4\frac{1}{2}$  to 5. Dorsal fin VI to VIII-9 or 10. Anal II, 6. Scales 34 to 39-9, no lateral line present; back of the neck, cheeks and breast naked; opercles with a few scales; scales ctenoid. Length 1 to  $1\frac{1}{2}$  inches.

This little darter is probably rather common in the streams and lakes of the Upper Mississippi, where a few specimens have been taken. Its very small size makes it difficult to collect. Specimens are now recorded from Pine Creek, Crow Wing County (Nat. Hist. Surv., 1892); at Grand Rapids (Woolman & Cox, 1894).

**Family SERRANIDÆ. The Sea Bass.**

Body compressed, oblong, covered with scales, these generally ctenoid. Mouth rather large; upper jaw protractile; maxillary bones broad. Teeth sharp and present on the jaws, vomer, tongue and palatine bones. Gill rakers armed with teeth; a slit behind the fourth gill; pseudobranchia well developed; lower pharyngeal teeth pointed; gill membranes free from the isthmus; branchiostegal rays 7; cheeks and opercles scaly; opercles with two flat



spines; lateral line not extending on the caudal fin. Dorsal spines stiff; ventral fins thoracic; pectoral fins well developed; air-bladder present; stomach with pyloric caeca; intestine short.

But one genus and one species known in the state.

### Genus **ROCCUS** Mitchill.

**Roccus chrysops** (Rafinesque). Striped Bass. White Bass. White Lake Bass

General color silvery, yellowish on the under parts; sides with narrow, dusky, longitudinal lines. Body compressed, deep, back elevated; head rather conical; mouth medium sized, horizontal, jaws about equal in length; eye about equal to the snout; maxillary extending to the middle of the eye, no supplemental bone; a deep notch in the subopercular bone; preopercle serrate; head scaly. Gill rakers long and slender, X-14; longest dorsal spine contained 2 times in the head. Head contained  $3\frac{1}{2}$  times in the length. Depth  $3\frac{1}{4}$ . Eye 5 in the head. Dorsal fin IX-I, 14. Anal III, 11 or 12. Scales 10-55 to 65-15. Base of the tongue as well as the jaws, vomer and palatines with teeth. Length 15 inches.

So far as recorded this fish has been taken at but one place in the state and that is Big Stone Lake, where it is reported as common. Several specimens were taken at this place in the summer of 1892 (Woolman & Cox).

### Family **SCIENIDÆ**. The Drums.

Body compressed, much the shape of a bass, somewhat elongate, all parts well covered with ctenoid scales, the scales extending over the bases of the vertical fins; lateral line well developed, extending on the caudal fin. Head large, covered with scales; teeth present on the jaws; no supplemental maxillary bone; upper jaw somewhat protractile; pseudobranchia well developed; a slit behind the fourth gill; gill rakers present; branchiostegal rays developed; gill membranes free from the isthmus. Dorsal fin deeply notched, the soft part much longer than the spinous. Anal fin with 1 or 2 spines. Ear bones (otoliths) well developed; air bladder large; pyloric caeca few.

Carniverous fishes which have the power of producing a peculiar grunting sound, supposed to be made by forcing air from the main portion of the air bladder into one of its smaller divisions. The family is represented in the state by but one genus and one species.

Genus **APLODINOTUS** Rafinesque.

**Aploдинотus grunniens** Rafinesque. Sheep's-head. Thunder Pumper.  
Drum. White Perch. Croaker.

Silvery in color, some specimens almost white, while others are quite dark; upper parts darker than the lower. Body oblong, snout blunt, the back much elevated and compressed; mouth large, horizontal, the lower jaw not extending beyond the upper. Ordinary teeth slender and closely crowded in velvety bands; pharyngeal teeth well developed, blunt and closely set to each other (paved). Preopercle slightly serrate. Dorsal spines strong and high, covered with scales at the base; anal spines two, the second very strong. Head contained  $3\frac{1}{2}$  times in length. Depth about 3. Dorsal IX-1, 30. Anal II, 7. Lateral line with 55 scales. Length 2 feet.

A very interesting fish on account of its power to produce a grunting noise. Rather common in the state. A very large specimen was taken from a pool in the Little Minnesota River at Brown's Valley and a number were taken from Big Stone Lake near the same place (Woolman & Cox, 1892); numerous specimens from the Minnesota' River have been seen in the markets at Mankato, and it is often caught in Lake Washington, near the same place, where its grunting is frequently noticed (Cox, 1891-5); two specimens have been taken from the Red Lake River at Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).

Family **COTTIDÆ**. The Sculpins.

Body elongate, the head very large and much depressed; eyes placed high in the head, the space between them being narrow; the upper edge of the opercle with one or more spinous processes. Teeth present on the jaws and usually on the vomer and palatines; upper jaw protractile; maxillary without supplemental bone. Gill rakers short, tubercle-like or even absent. Body naked or covered with scales, prickles or bony plates, never entirely scaled. Lateral line present; pectoral fins large; ventral fins thoracic; pseudo-branchia present; generally 4 to 8 pyloric cæca.

This family is represented in the state by one genus and one species.

Genus **COTTUS** (Artedi) Linnæus.

**Cottus ictalops** (Rafinesque). Miller's Thumb. Blob. Muffle-jaw.

General color dark brown or grayish, lighter below, often barred or dotted. Body rather stout, tapering towards the tail; head large and much flattened above, wide through the opercular region; preopercle with a sharp, short spine, which is directed backwards and upwards; subopercle with a spine which is directed forwards. Skin smooth, except just back of the pectoral fins, where it is often covered with sharp prickles; lateral line present. First dorsal fin low and weak; pectorals very large, about equal to the head in length. Head contained  $3\frac{1}{3}$  times in the length. Depth 4 to 6. Dorsal fin VI to VIII-16 or 17. Anal about 12. Ventrals each I, 4. Length 3 to 7 inches, usually small.

A common fish in the northern part of the state. Numerous specimens have been taken in the Upper Mississippi and tributaries (Nat. Hist. Surv., 1893-5); Upper Mississippi (Woolman & Cox, 1894).

Family **GADIDÆ**. The Cod-fishes.

Body long, rather slender; heavy anteriorly, compressed posteriorly. Scales small, or even wanting, cycloid; gill membranes free from the isthmus. Dorsal fin very long, extending almost the entire length of the back and in some species divided into two; no spines present in any of the fins; caudal fin rounded; ventral fins inserted far forward. Four gills, with a slit behind the fourth; no pseudobranchia present. Pyloric cæca numerous in some species; air bladder generally well developed.

This well known family is represented by but one genus and one species in the state, it being the only species found in fresh water.

Genus **LOTA** (Cuvier).

**Lota maculosa** (Le Sueur). Burbot. Lawyer. Ling.

General color dark olive, much mottled with blackish; lower parts yellowish; general color becoming more yellowish in the adult; young often with a red band on the dorsal fin, the outer edge of the fin dusky. Body long and heavy anteriorly, compressed posteriorly; head rather small, depressed and broad, and a barbel on each of the anterior nostrils; mouth moderate, lower jaw not projecting; maxillary extending to the posterior edge of the eye; jaws set with weak teeth, which are very numerous

and arranged in bands; vomer with a crescent shaped band of teeth, palatines toothless. Scales very small and imbedded in the skin, extending on the vertical fins. Gill openings wide; gill membranes free from the isthmus. Dorsal fins two, the second longest. Eye very small. Head  $4\frac{2}{3}$ . Depth 6. Dorsal 13-76. Anal 68. Ventrals each 7. Pyloric caeca 30. Length 2 feet.

Rather common in the state, but not often found in large numbers. Numerous specimens have been taken from the streams and lakes of the Upper Mississippi, Lake Vermillion (Nat. Hist. Surv., 1893-5); specimens are recorded from the Red River of the North at Moorhead and from the Red Lake River at Crookston (Woolman, 1892, Report U. S. Fish Comm., 1893).



## SUMMARY.

In the preceding pages are listed and described twelve orders, twenty-five families, sixty genera, one hundred and four species, and six additional varieties. The following list shows the distribution of these species and varieties among the various families and orders.

There are no definite data concerning two of the species (*Ameiurus lacustris* and *Leptops oliaris*), but they have, no doubt, been taken in the Mississippi and its tributaries. Where a variety form alone is represented and not the species, the variety is enumerated as a species, but when the typical species and the variety occur, the variety is enumerated as one of the six referred to above.

### CLASS MARSIPOBRANCHII.

#### ORDER HYPEROARTII.

Family **PETROMYZONIDÆ**. The Lampreys.

Genus **Ichthyomyzon** Girard.

**I. concolor** (Kirtland).

**I. castaneus** Girard.

### CLASS PISCES.

#### ORDER SELACHOSTOMI.

Family **POLYODONTIDÆ**. The Paddle-fishes.

Genus **Polyodon** Lacépède.

**P. spathula** (Walbaum).

#### ORDER CHONDROSTEL.

Family **ACIPENSERIDÆ**. The Sturgeons.

Genus **Acipenser** Linnæus.

**A. rubicundus** Le Sueur.

Genus **Schaphirhynchus** Heckel.

**S. platorynchus** (Rafinesque).

**ORDER RHOMBOGANOIDEA.**Family **LEPISOSTEIDÆ**. The Gar-fishes.Genus **Lepisosteus** Lacépède.**L. osseus** (Linnæus).**L. platostomus** Rafinesque.**ORDER CYCLOGANOIDEA.**Family **AMIIDÆ**. The Bow-fins.Genus **Amia** Linnæus.**A. calva** Linnæus.**ORDER NEMATOGNATHI.**Family **SILURIDÆ**. The Cat-fishes.Genus **Ictalurus** Rafinesque.**I. punctatus** (Rafinesque).Genus **Ameiurus** Rafinesque.**A. lacustris** (Walbaum).**A. natalis** (Le Sueur).**A. vulgaris** (Thompson).**A. nebulosus** (Le Sueur).**A. melas** (Rafinesque).Genus **Leptops** Rafinesque.**L. olivaris** (Rafinesque).Genus **Noturus** Rafinesque.**N. flavus** Rafinesque.Genus **Schilbeodes** Blecker.**S. gyrinus** (Mitchill).**S. exilis** (Nelson).**ORDER PLECTOSPONDYLI.**Family **CATOSTOMIDÆ**. The Suckers.Genus **Ictiobus** Rafinesque.**I. cyprinella** (Cuvier & Valenciennes).**I. bubalus** (Rafinesque).Genus **Carpiodes** Rafinesque.**C. carpio** (Rafinesque).

**C. difformis** Cope.

**C. velifer** (Rafinesque).

Genus **Cycleptus** Rafinesque.

**C. elongatus** (Le Sueur).

Genus **Catostomus** Le Sueur.

**C. catostomus** (Forster).

**C. commersonii** (Lacépède).

**C. nigricans** Le Sueur.

Genus **Moxostoma** Rafinesque.

**M. anisurum** (Rafinesque).

**M. aureolum** (Le Sueur).

Family **CYPRINIDÆ**. The Minnows.

Genus **Campostoma** Agassiz.

**C. anomalum** (Rafinesque).

Genus **Chrosomus** Rafinesque.

**C. erythrogaster** Rafinesque.

Genus **Hybognathus** Agassiz.

**H. nuchalis** Agassiz.

Genus **Pimephales** Rafinesque.

**P. promelas** Rafinesque.

**P. notatus** (Rafinesque).

Genus **Semotilus** Rafinesque.

**S. atromaculatus** (Mitchill)

Genus **Leuciscus** Cuvier.

**L. nachtriebi** Cox.

Genus **Abramis** Cuvier.

**A. crysoleucas** (Mitchill).

Genus **Notropis** Rafinesque.

**N. anogenus** Forbes.

**N. cayuga** Meek.

**N. heterodon** (Cope).

**N. blennius** (Girard).

**N. hudsonius** (De Witt Clinton).

**N. hudsonius selene** (Jordan).

**N. whipplii** (Girard).

**N. cornutus** (Mitchill).

**N. cornutus frontalis** (Agassiz).

**N. jejunos** (Forbes).

**N. atherinoides** Rafinesque.

**N. dilectus** (Girard).

**N. rubrifrons** (Cope).

**N. umbratilis** (Girard).

Genus **Rhinichthys** Agassiz.

**R. cataractæ** (Cuvier & Valenciennes).

**R. atronasus** (Mitchill).

**R. atronasus lunatus** (Cope).

Genus **Hybopsis** Agassiz.

**H. hyostomus** (Gilbert).

**H. storerianus** (Kirtland).

**H. kentuckiensis** (Rafinesque).

## ORDER APODES.

Family **ANGUILLIDÆ**. The True Eels.

Genus **Anguilla** Shaw.

**A. chrysypa** Rafinesque.

## ORDER ISOSPONDYLI.

Family **HIODONTIDÆ**. The Moon-eyes.

Genus **Hiodon** Le Sueur.

**H. tergisus** Le Sueur.

Family **DOROSOMIDÆ**. The Hickory Shad.

Genus **Dorosoma** Rafinesque.

**D. cepedianum** (Le Sueur).

Family **SALMONIDÆ**. The Salmon.

Genus **Coregonus** (Artedi) Linnaeus.

**C. clupeiformis** (Mitchill).

Genus **Argyrosomus** Agassiz.

**A. artedi** (Le Sueur).

**A. prognathus** (H. M. Smith).

**A. nigripennis** Gill.

**A. tullibee** (Richardson).

Genus **Cristivomer** Gill & Jordan.

**C. namaycush** (Walbaum).

**C. namaycush siscowet** (Agassiz).

Genus **Salvelinus** (Nilsson) Richardson.

**S. fontinalis** (Mitchill).



**ORDER HAPLOMI.**

Family **UMBRIDÆ**. The Mud Minnows.

Genus **Umbra** (Krämer) Müller.

**U. limi** (Kirtland).

Family **LUCIIDÆ**. The Pikes.

Genus **Lucius** Rafinesque.

**L. lucius** (Linnæus).

**L. masquinongy** (Mitchill).

Family **PŒCILIIDÆ**. The Killifishes.

Genus **Fundulus** Lacépède.

**F. diaphanus** (Le Sueur).

**ORDER HEMIBRANCHII.**

Family **GASTEROSTEIDÆ**. The Sticklebacks.

Genus **Eucalia** Jordan.

**E. inconstans** (Kirtland).

**E. inconstans pygmæa** (Agassiz).

Genus **Pygosteus** Brevoort.

**P. pungitius** (Linnæus).

**ORDER ACANTHOPTERI.**

Family **PERCOPSIDÆ**. The Sand Rollers.

Genus **Percopsis** Agassiz.

**P. guttatus** Agassiz.

Family **APHREDODERIDÆ**. The Pirate Perches.

Genus **Aphredoderus** Le Sueur.

**A. sayanus** (Gilliams).

Family **ATHERINIDÆ**. The Silversides.

Genus **Labidesthes** Cope.

**L. sicculus** (Cope).

Family **CENTRARCHIDÆ**. The Sunfishes.

Genus **Pomoxis** Rafinesque.

**P. annularis** Rafinesque.

**P. sparoides** (Lacépède).

Genus **Ambloplites** Rafinesque.

**A. rupestris** (Rafinesque).

Genus **Apomotis** Rafinesque.

**A. cyanellus** (Rafinesque).

**A. ischyus** (Jordan & Nelson).

Genus **Lepomis** Rafinesque.

**L. megalotis** (Rafinesque).

**L. humilis** (Girard).

**L. pallidus** (Mitchill).

Genus **Eupomotis** Gill & Jordan.

**E. euryorus** (MacKay).

**E. gibbosus** (Linnæus).

Genus **Micropterus** Lacépède.

**M. dolomieu** Lacépède.

**M. salmoides** (Lacépède).

Family **PERCIDÆ**. The Perches.

Genus **Stizostedion** Rafinesque.

**S. vitreum** (Mitchill).

**S. canadense griseum** (De Kay).

Genus **Perca** (Artedi) Linnæus.

**P. flavescens** (Mitchill).

Genus **Percina** Haldeman.

**P. caprodes** (Rafinesque).

**P. caprodes zebra** (Agassiz).

Genus **Hadropterus** Agassiz.

**H. aspro** (Cope & Jordan).

**H. güntheri** (Eigenmann & Eigenmann).

Genus **Boleosoma** De Kay.

**B. nigrum** (Rafinesque).

Genus **Ammocrypta** Jordan.

**A. pellucida clara** Jordan & Meek.

Genus **Etheostoma** Rafinesque.

**E. zonale** (Cope).

**E. iowæ** Jordan & Meek.

**E. cœruleum** Storer.

**E. flabellare lineolatum** (Agassiz).

Genus **Boleichthys** Girard.

**B. fusiformis** (Girard).

**B. exilis** Girard.

Genus **Microperca** Putnam.

**M. punctulata** Putnam.

Family **SERRANIDÆ**. The Sea Bass.

Genus **Roccus** Mitchill.

**R. chrysops** (Rafinesque).

Family **SCIÆNIDÆ**. The Drums.

Genus **Aplodinotus** Rafinesque.

**A. grunniens** Rafinesque.

Family **COTTIDÆ**. The Sculpins.

Genus **Cottus** (Artemi) Linnæus.

**C. ictalops** (Rafinesque).

Family **GADIDÆ**. The Cod-fishes.

Genus **Lota** Cuvier.

**L. maculosa** (Le Sueur.)

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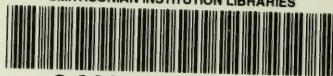








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